



## **San Pedro Bay Ports Sustainable Supply Chain Advisory Committee *May Meeting Summary***

**Date:** May 20<sup>th</sup>, 2020 | 11:00 am – 3:00 pm

**Location:** Via phone conference

**Attachments:** Attachment A - Attendees  
Attachment B - Meeting Agenda  
Attachment C - Finalized March Meeting Minutes  
Attachment D - Meeting Presentation  
Attachment E - Infrastructure Roundtable Primer - Committee  
Attachment F - Infrastructure Roundtable Primer - Speakers  
Attachment G - Infrastructure Roundtable Primer - General

### ***Meeting Agenda***

1. Online Meeting Protocol (GNA)
  - a. GoTo Webinar Features – Q&A, Screen Sharing, Mute, Video
  - b. Best Practices for GoTo Webinar
  
2. POLA / POLB Opening Remarks
  - a. Reporting on the summary effects of the COVID-19 pandemic, the ports noted a drop in cargo volumes and associated blank sailing issues, but affirmed the ports' commitment to moving forward with and making progress on their environmental and clean air programs.
  - b. Both ports will update their respective boards on development of the Clean Truck Program (CTP) in July. The ports advised that their boards will be monitoring economic recovery indicators as they evaluate the CTP proposal, and, that the program will not move forward until CARB has ruled on its Low NOx Omnibus this year. These factors may push the CTP implementation schedule to late 2020.
  
3. Review & Approve March Meeting Summary
  - a. The Committee approved the March Meeting Summary.
  
4. Review of Committee Recommendations
  - a. Hybridization of RTGs and Top Handlers
    - i. Heather Arias (CARB) recused herself from this recommendation due to the conflict with CARB's rulemaking process on cargo-handling equipment.
    - ii. The Committee members present at the meeting approved the recommendation.
    - iii. **Approval of the finalized recommendation will be sought from the remaining Committee members not present at the meeting, and upon their approval, submitted to both Ports and Mayoral Offices, and posted on the Committee website.**



- b. Harbor Maintenance Trust Fund Letter of Support
    - i. Adrian Martinez (EarthJustice) recused himself from the letter due to conflicts of interest with EarthJustice's work on these issues.
    - ii. The Committee approved the Letter of Support. **Approval of the finalized letter of support will be sought from the remaining Committee members not present at the meeting, and upon their approval, will be submitted to Congress prior to the June session.**
  - c. Proposed Recommendation
    - i. Joe Lyou (CCA/CTC) suggested that the Committee develop a recommendation that funds received for Port infrastructure support the CAAP targets.
    - ii. The Committee agreed that GNA will convene a sub-committee to develop a draft of this recommendation for Committee consideration.
    - iii. The Committee emphasized the value of the ports' progress report on the SSCAC recommendations (delivered in January) and requested that similar updates be provided at least twice a year.
    - iv. **The existing reporting structures will be reviewed in order to identify an approach that meets the Committee's requirements for a regular update going forward.**
    - v. In addition, the Committee requested an update on South Coast AQMD's Task Order to develop a project data clearinghouse that tracks key indicators of heavy-duty vehicle and equipment demonstrations and deployments in California. South Coast AQMD reported that it has executed this Task Order with GNA and will begin developing this resource in Q2 2020. It was noted that information from the project reporting submitted to the ports could be used as an input into this clearinghouse effort.
    - vi. **An update on the clearinghouse effort will be provided at the next SSCAC meeting.**
5. South Coast AQMD Facility-Based Mobile-Source Measures (South Coast AQMD)
- a. Ian MacMillan (South Coast AQMD) updated the Committee on the development of two regulations.
    - i. Warehouse Indirect Source Rule (ISR) – this rule will use a point program to incentivize warehouse operators to operate or attract fleets operating NZE/ZE trucks to their facilities. Funds received under this program will subsidize the purchase and use of NZE/ZE trucks in surrounding communities.
      - South Coast AQMD is currently reviewing comments received on the draft rule and expects to convene a working group in summer 2020. At this point in time, the finalized rule will be presented to the board in early 2021.
    - ii. Railyard ISR – South Coast AQMD is coordinating with CARB on four concepts for regulating locomotive emissions, in order to align with CARB's own four statewide concepts. South Coast AQMD's concepts are:
      - Use emissions control equipment, buffering and maintenance requirements to reduce local community exposure;
      - Prepare site-specific zero-emissions infrastructure plans to inform regulatory agency actions on ZE equipment adoption;
      - Design an incentive program tied to clean, rather than replacement, equipment; and



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- Evaluate new monitoring technologies to track equipment smoking activity, and inform regulatory actions to limit emissions.
      - iii. Ian confirmed that the enforcement of monitoring and reporting requirements under both ISRs is being considered. Both desktop and field audits will be considered, and South Coast AQMD is considering how air quality monitoring technology could also be utilized.
      - iv. CARB noted that they are coordinating with South Coast AQMD to host workshops on the Railyard ISR in summer 2020, and aiming for a board proposal in 2021.
    - b. The South Coast AQMD and the ports are meeting weekly in order to finalize the key points for a Memorandum of Understanding (MOU) between the parties. Truck emission issues and the Clean Truck Program are a key point of discussion in these meetings.
- 6. Updates on CARB Activities (CARB, CEC)
  - a. Joint CARB/CEC ZE Drayage Truck RFP (\$40M)
    - i. Sydney Vergis and Ben DeAlba reported on the joint CEC and ARB efforts to develop and release a \$40M RFP for projects that deploy at least 50 zero emission drayage / regional haul trucks and refueling infrastructure. A workgroup will be hosted on June 11<sup>th</sup> to further define program details, as well as the processes for applying for and receiving funds from the two agencies.
    - ii. Michael Samulon noted that the City of LA supports measures that improve the efficiency of deployments, and requested that the Committee be informed of such measures as they are identified so that it can express its support to the appropriate legislative parties.
    - iii. It was noted that one of the Committee's first recommendations in 2016 was for the development of a 50 to 100 unit zero-emission truck pilot project, and that this step indicates the Committee's support for the joint agency effort to make this possible for the ports.
  - b. Low NOx Omnibus Rule
    - i. Michael Carter (CARB) reported that the revised draft rule will be released for public comment on June 26<sup>th</sup>, and that it is currently designed to go into effect with the 2024 engine model year. The regulation will have a California standard at 0.05g/bhp-hr NOx, as well as an optional 50-state standard of 0.1g/bhp-hr NOx. OEMs can certify individual engines sold in California to the California standard, or all OEM engines sold in the U.S. to the 50-state standard. In 2027, the standard will drop to 0.02g/bhp-hr NOx and the optional 50-state standard will cease to be available.
  - c. ARB provided updates on the At-berth Rule, Harbor Craft Rule and eTRU Regulation. The Committee observed that CARB and the CEC should coordinate its rulemaking efforts with Caltrans and the California Transportation Commission, to ensure alignment for clean freight funding.
- 7. Next SSCAC Meeting
  - a. July 15<sup>th</sup>, 2020; 11 am – 3 pm PDT
  - b. Location TBD
- 8. Infrastructure Stakeholder Roundtable



- a. Introduction & GoTo Webinar Protocol (GNA)
- b. Overview of San Pedro Bay Port Drayage Needs (GNA, Ports)
- c. Facilitated Roundtable Discussion
  - i. Natural Gas
  - ii. Hydrogen
  - iii. Battery Electric
- d. Opportunity for Committee Action

#### Overview:

The Ports' Sustainable Supply Chain Advisory Committee (SSCAC) invited fuel infrastructure and fuel providers from the natural gas, electricity and hydrogen industries to have an interactive dialogue on the market for near-zero and zero emission fueling infrastructure required to meet the ports' drayage fleet emission targets. As the Clean Air Action Plan (CAAP) calls for aggressive measures to drive investment and deployment of near-zero emission technology in the near term, and zero emission technology by 2035, the Committee is seeking an understanding of the current and anticipated fuel infrastructure landscapes for these technologies.

#### Summary of Discussion

To establish a foundation of the Port's expected needs for its clean truck transition, GNA presented a high-level description of the drayage truck fleet population, its estimated energy requirements from each of the subject alternative fuels, and key relevant results of the Ports' 2018 Drayage Truck Technical Feasibility Assessment (**Attachment D**). Referring to the overarching question, "What does the ports' goal of 'transitioning the current drayage truck fleet to a near-zero and ultimately zero emissions drayage trucking fleet by 2035' mean for building out the fueling infrastructure in the harbor and throughout the region to support this transition of this 12,000 to 18,000 truck fleet?", Roundtable guests were then asked to respond to a series of questions that had been previously circulated (**Attachments E and F**), with approximately 30-45 minutes allotted to each fuel.

#### *Natural Gas*

- The ports articulated their expectation that natural gas would provide the emission reductions necessary to reach their short-term air quality attainment deadlines, while the technology for zero-emission trucks matures and the drayage fleet begins its transition to meet the 2035 target. The Port of Los Angeles added that actions taken in the short term should not jeopardize long term goals of zero emission, which the City affirmed as real, firm targets.
- Fuel and station providers Trillium and Clean Energy pointed out that natural gas fueling infrastructure currently exists in the port fleets' region of travel, and that this existing regional infrastructure could easily accommodate a several years of aggressive natural gas truck deployments at +/- 2,000 new trucks per year. During this period, the natural gas fuel and fueling infrastructure industry would deploy private capital to build incremental fueling infrastructure needed to support a more aggressive deployment of near-zero emission natural gas trucks.
- The natural gas industry stakeholders pointed out a challenge with the heavy focus on the long-term goal of zero-emission technology; it devalues the business case for investment in near-term emission reduction technology – i.e. near-zero emission natural gas trucks and renewable / low-carbon natural gas fuel. It therefore creates a challenge to achieving the



ports' commitment to near-term emission reduction goals, and a broader challenge to the region meeting near-term regional air quality attainment deadlines. The Committee noted that stronger involvement from the ports is needed to develop the business case required to support their near-term emission reduction goals. In particular, cost-effectiveness was identified as an important metric to use to prioritize port investments and prevent the continued use of 0.2 g/bhp-hr diesel engines.

- Renewable natural gas (RNG) was recommended as a decarbonizing solution. Clean Energy pointed to the U.S. current capacity to replace 75 percent of on-road diesel fuel throughput with RNG, and observed that the companies at the Roundtable are able to develop the infrastructure to handle this throughput for the ports in a relatively short period of time. Trillium added that the build time for a large-scale natural gas refueling station is 9 to 12 months, and that real estate prices around the San Pedro Bay are the biggest challenge to development.
- The natural gas industry representatives noted that significant growth of fueling infrastructure has been implemented in the past, and replicating such development is not a challenge. The industry stands ready to invest private capital in this infrastructure expansion, as long as the trucks / customers are certain to show up. Existing infrastructure can accommodate several years of natural gas drayage truck growth, with incremental stations being built with private capital as demand increases. There is sufficient and growing sources of low carbon RNG to ensure that all port drayage trucks can fuel with RNG.

### *Hydrogen*

- Industry representatives described their current and forecasted fuel and infrastructure production capacities, noting that hydrogen supply is expected to grow over the next 15 years. Shell and Air Products observed that 2035 is a realistic timeline to transition to zero emission technology from a fueling infrastructure perspective, but that this holds true if the pace of beginning, and scaling, deployments is well-managed over the interim with clear milestones. Nikola added that permitting is time- and cost- intensive.
  - Air Liquide is preparing to supply 30 tons of liquid hydrogen per day to the West Coast mobility market. While this is expected to contribute to the ports' target, Air Liquide noted that it considers both hydrogen and battery electric powertrains as important solutions for the heavy-duty market going forward, with each technology serving specific applications. Air Liquide added that it is prepared to invest in existing opportunities.
  - Shell noted that hydrogen is one part of its new fuels business, and that this team is approaching it objectively to determine where and what applications hydrogen is a strong investment. Agreeing with Air Liquide, Shell said that fleet and duty cycles are an important part of its consideration, and added that hydrogen is attractive over a long-term horizon because it scales well.
  - Nikola is preparing to build a network of hydrogen fueling stations, starting with the I-10 corridor, in time to support its first commercial sales of trucks in 2023. Nikola reported that its standard vehicle fueling station produces 8 tons of hydrogen per day (with the opportunity to scale to a larger volume), requires 6 acres for onsite production, and costs \$16MM to build. The company estimates that 34 of these stations would be required to meet the ports' forecasted truck energy requirements under a 100% FCEV scenario. Station build time is estimated at 24 months per station, with the first 6 months committed to permitting.



- Elaborating on cost, Nikola noted that electricity is a critical cost for its hydrogen production, which relies on electrolysis. This factor means that production in California is fairly expensive given the state's high electricity rates relative to other states.
- While incentives are welcome, Nikola's business model is based on raising private funds, primarily equity with some debt.
- Air Products observed that facilities producing less than 8 tons/day could be suitable for some portions of the drayage market, and suggested that a current heat map of the ports' drayage fleet trips would be a useful resource for the fueling industry to fully respond to the forecasted need. Air Products noted that it is developing 4 to 10 ton liquid hydrogen production facilities for the transit market, which require less physical space than electrolysis facilities and would be less capital-intensive. However, developing a large-scale hydrogen station could take 3 years. Air Products noted the critical need to gain greater market certainty on the roll out of zero emission trucks in the ports, including timing
- Shell observed that it views the existing hydrogen infrastructure and trucks today as first generation, and, that there is no clear timeline for or scale of the second generation of equipment. This contributes to an initially high capital cost. As it evaluates the opportunity in hydrogen fuel production, it is taking OEM vehicle investments and sales, and fuel cell stack production, into account. Air Products emphasized that predictability is a challenge for long-term production planning, and that closer collaboration with funding and regulatory agencies is needed to move forward productively.
  - FuelCell Energy added that regulatory hurdles can significantly affect a project's duration and budget.
- Addressing the ports' zero emission target, FuelCell Energy noted that if the target requires a transition to zero-carbon inputs for hydrogen production, then that transition will require additional time which is often overlooked.

### *Battery Electric*

- The major utilities serving the San Pedro Bay Ports reported that they are in the early stages of supporting the further development of commercial fleet fueling infrastructure, and that they anticipate the demand will initially come from large fleet customers. Pointing to its commitment to invest \$15MM in infrastructure including wireless and DC fast charging through 2025, LADWP said it is also upgrading the capacity of any infrastructure when it is being replaced, wherever possible. SCE noted that it is focusing on identifying sites for large charging facilities, and anticipates that large fleets will be the first to transition while IOOs, such as drayage truck drivers, will transition at a later date as vehicle prices drop.
  - Greenlots said that it anticipates a slow initial adoption rate with few, small-scale stations, and added that in-route solutions can be addressed after large fleets have begun to transition.
  - ChargePoint emphasized the point made on the previous panels that a detailed, current heat map would give the fueling industry a clearer idea of the investment opportunities in the region. ChargePoint suggested that the ports consider origin-destination tracking on their trucks to build this data set.
- Referring to the 10-20 MW of service needed to support the development of a large-scale truck-stop style electric truck charging station, GNA observed that SCE had previously anticipated that that supply would require 7 to 10 years of development. Thus, to meet the



ports' 2035 target of zero-emission drayage operations, a mere 5-year window remains to develop the investment strategy.

- Trillium, Greenlots noted that they require an anchor fleet in order to invest in infrastructure, stating that speculative demand - such as the ports' - is not sufficient justification to develop new infrastructure today.
- The industry representatives suggested that current fueling station populations and new investments should be studied as an indicator of where BEV charging may or may not be a good fit, and to identify if any investments could be leveraged for BEV equipment in the future to reduce costs.
- Greenlots added that, in addition to a heat map, details of parking areas, vehicle use, and duty cycles are needed to begin a station build. Because this information is not currently available for the port drayage fleet, station developers would be unable to forecast the time and cost to deliver charging services.
- All BEV infrastructure providers agreed that greater clarity on the timing and rollout of zero emission trucks by the ports would be tremendously helpful as they seek to develop business plans for the implementation of the necessary charging infrastructure to support the ports' 2035 zero emission drayage truck goals.
- Financing was raised as a complicated but critical concern. Incentives are important drivers for fleet adoption, which subsequently prompts fleet engagement with charging service providers. The industry representatives agreed that without incentives, the costs of vehicles as well as infrastructure are difficult for the average port drayage truck driver to attain. Additionally, due to the pre-commercial status of the Class 8 BEV industry generally, incentives are required over the long term to maintain fleet customer interests at the time when these vehicles are fully commercialized. The group suggested that reserving and aligning incentives to kick in when OEMs begin selling trucks may be a useful approach to ensure a smooth adoption process.
  - Trillium added that regulations around the use of funds, and the sale of electricity, limit the business case for fuel station owners. Trillium noted that it is currently working with partners to modify the California Public Utilities' Commission's Rule 18 preventing the resale of electricity to MD and HD fleets for profit.
  - AMPLY added that electricity offtakers are an important factor of a charging station business model that helps attract investment.





## Attachment A

### List of Meeting Participants

<b>SSCAC Committee Members</b>	
Michele Grubbs	PMSA
Thomas Jelenic	PMSA
Matt Miyasato	South Coast AQMD
Heather Arias	CARB
Marnie Primmer	FuturePorts
Stella Ursua	Grid Alternatives
Joe Lyou	CCA/CTC
Adrian Martinez	EarthJustice
<b>Los Angeles Port &amp; City Staff</b>	
Chris Cannon	Port of Los Angeles
Erick Martell	Port of Los Angeles
Jennifer Cohen	Port of Los Angeles
Tim DeMoss	Port of Los Angeles
Max Reyes	City of LA, Mayor's Office
Lauren Faber O'Connor	City of LA, Mayor's Office
Michael Samulon	City of LA, Mayor's Office
Jacob Haik	Councilman Joe Buscaino's Office
<b>Long Beach Port &amp; City Staff</b>	
Heather Tomley	Port of Long Beach
Eleanor Torres	Port of Long Beach
Bianca Villanueva	Port of Long Beach
Morgan Caswell	Port of Long Beach
Wei Chi	Port of Long Beach
Justin Ramirez	City of Long Beach, Mayor's Office
<b>Meeting Facilitation Staff</b>	
Erik Neandross	GNA
Eleanor Johnstone	GNA
Patrick Couch	GNA
Alexis Wiley	GNA
Benjamin Chan	GNA
<b>Roundtable Speakers</b>	
Greg Roche	CleanEnergy
Scott Hanstedt	GAIN
Kevin Maggay	SoCal Gas
Shawn Murphy	Shell





Wayne Leighty	Shell
Ryan Forrest	Trillium
Charles Sanders	Air Liquide
Jordan Truitt	Air Liquide
Christine Kretz	Air Products
Paul Fukumoto	FuelCell Energy
Bill Cherry	Nikola
Dale Prows	Nikola
Elizabeth Fretheim	Nikola
Rob Kelly	AMPLY
David Peterson	ChargePoint
Lin-Zhuang Khoo	Greenlots
Ashley Horvat	Greenlots
Louis Ting	LADWP
Eric Seilo	SCE
Damon Hannaman	SCE
<b>Other Stakeholders</b>	
Ben DeAlba	CEC
Michelle Vater	CEC
Alexander Wan	CEC
Sydney Vergis	CARB
Michael Carter	CARB
Bonnie Soriano	CARB
Ian MacMillan	South Coast AQMD
Zorik Pirveysian	South Coast AQMD
Naveen Berry	South Coast AQMD
Jessica Alvarenga	PMSA
Michael Canom	LA Metro
Clay Collier	ChargePoint
Idine Ghoreishian	Greenlots
Ray Gorski	South Coast AQMD
Nathan Hill	Daimler Trucks North America
Jason Hills	LADWP
Jennifer Kropke	IBEW Local 11
Alana Langdon	Nikola
Alison Linder	Southern California Association of Governments
Annie Nam	Southern California Association of Governments
Nancy Pfeffer	Gateway Cities Council of Governments



James Shankel	Caltrans
Hannah Walter	California Transportation Commission



## **Attachment B**

# **San Pedro Bay Ports Sustainable Supply Chain Advisory Committee**

***May 20<sup>th</sup> | 11 am – 3 pm | Online / Dial-in Conference***  
***GoTo Webinar – Individual Log-in Details to be emailed separately***  
***Meeting Agenda***

1. Online Meeting Protocol (GNA)
  - a. GoTo Webinar Features – Q&A, Screen Sharing, Mute, Video
  - b. Best Practices for GoTo Webinar
2. POLA / POLB Opening Remarks
3. Review & Approve March Meeting Summary
4. Review of Committee Recommendations
  - a. Hybridization of RTGs and Top Handlers
  - b. Harbor Maintenance Trust Fund Letter of Support
  - c. Proposed Recommendation
5. SCAQMD Facility-Based Mobile-Source Measures (South Coast AQMD)
6. Updates on CARB Activities (CARB, CEC)
  - a. Joint CARB/CEC ZE Drayage Truck RFP (\$40M)
  - b. Low NOx Omnibus Rule
  - c. At-berth Rule
  - d. Harbor Craft Rule
  - e. eTRU Regulation
7. Next SSCAC Meeting
  - a. July 15<sup>th</sup>, 2020 ; 11 am – 3 pm PDT
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8. Infrastructure Stakeholder Roundtable
  - a. Introduction & GoTo Webinar Protocol (GNA)
  - b. Overview of San Pedro Bay Port Drayage Needs (GNA, Ports)
  - c. Facilitated Roundtable Discussion
    - i. Natural Gas
    - ii. Hydrogen
    - iii. Battery Electric
  - d. Opportunity for Committee Action
9. Conclusion & Next Steps



## **Attachment C**

Finalized March 2020 SSCAC Meeting Summary



## San Pedro Bay Ports Sustainable Supply Chain Advisory Committee *March Meeting Summary*

**Date:** March 18<sup>th</sup>, 2020 | 11:00 am – 3:00 pm

**Location:** Via phone conference

**Attendees:** Attachment A

**Meeting Agenda:** Attachment B

### *Meeting Agenda*

Due to the COVID-19 outbreak, this meeting was held via a video conference instead of the usual in-person meeting.

1. Online Meeting Protocols (GNA)
  - a. GNA provided an overview of best practices for efficient and effective virtual meetings
2. POLA / POLB Opening Remarks
  - a. The ports provided a summary update of their respective protocols to maintain operations safely in the face of COVID-19. Both ports noted that ship calls have dropped significantly in Q1 but pointed out that manufacturing facilities in China are ramping back up as the quarter closes.
3. Review & Finalize January Meeting Summary
  - a. Committee members clarified the terms of their January discussion regarding air quality attainment deadlines and discussed an appropriate edit to item 6.d. in the meeting summary. The document was updated, and the final version was circulated to the Committee and approved on Friday, March 20<sup>th</sup> (**Attachment C**).
4. Updates on CARB Regulatory Measures (Heather Arias)
  - a. CARB provided an update on its COVID-19 response and work-from-home policy, advising the Committee on best practices and expectations for engaging CARB staff over the next few weeks.
  - b. Heather advised that due to the virus, CARB's Board meeting in March has been cancelled. When Board meetings resume, agenda items that must comply with the Office of Administrative Law (OAL) deadlines will be prioritized.
  - c. Low NOx Omnibus



- i. CARB is on track to present its proposal for a new standard and strengthening of in-use testing programs to its Board in June, although this presentation is subject to adjustment per point 4.b. above.
    - d. At-berth Rule
      - i. Since this rule was presented to the Board in December, CARB has been adding vessel types to the list of affected equipment and strengthening the existing requirements. The updated proposal is expected to include a remediation fund for use by the ports and third-party control system operators.
      - ii. Responding to a question from the Committee, Heather clarified that CARB is not considering changes to the compliance deadlines established under the existing rule in response to the economic effects of COVID-19.
    - e. \$20MM - \$40MM ZE Drayage Fund
      - i. Heather confirmed that a total of \$40MM will be made available from CARB's joint effort with the California Energy Commission (CEC), and said that the agencies will host a joint workshop to further define the fund's applications and goals. This workshop will likely be held in the summer, with a solicitation opened in the fall.
      - ii. Responding to the Committee's inquiry about efforts to leverage existing infrastructure funding from utility programs, Heather said that the agencies support maximizing the reach of their funds but that the specific areas where each agency's funds could be applied has not yet been defined.
      - iii. **The Committee agreed to have a deeper discussion with CARB's Mobile Source Control Division and the relevant CEC entity on the opportunities to optimize this Fund's application in the May 2020 Committee meeting.**
    - f. Harbor Craft
      - i. The current proposal allows for a phased-in implementation starting in 2023 and running through 2030, which includes facility reporting requirements. The proposal will be brought to the Board in 2021.
- 5. Proposed Recommendation: Harbor Maintenance Tax fund allocation (CCA, PMSA)
  - a. Overview (David Libatique)
    - i. The HMT has been collected on cargo throughout the US since 1986, yielding \$1.5Bn - \$2Bn annually to support operations and maintenance dredging in port areas across the U.S. The San Pedro Bay Ports' contributions account for approximately 30% of the total HMT revenue, however only 2% is allocated back to the SPBP complex. All funds are not regularly allocated, and a surplus has accumulated.
    - ii. Since 2012, the Ports have been trying to secure a pathway to receive a more equitable share of the HMT fund, and to apply it to a wider range of port needs. As part of the American Association of Port Authorities



(AAPA), the Ports are currently advocating that the full amount of HMT revenue generated each year be allocated, as well.

- iii. It was noted that if a more equitable amount of the HMT revenue can be returned to donor ports, it is unlikely that the funds could be used for any land side projects. However, in this scenario, existing Ports funds being used for harbor maintenance could potentially be reallocated to land side projects.
- iv. **The Committee recommended that it submit a letter supporting the AAPA's proposal, and if successful, further recommend that revenue be applicable towards zero- and near zero- emission equipment and fueling infrastructure.**
  - Committee members highlighted that this action would also illustrate the Committee's support for local communities affected by air pollution from the San Pedro Bay Port complex.
  - Committee member Adrian Martinez of EarthJustice recused himself from this recommendation due to a conflict of interest.

## 6. Lunch

## 7. Presentation - Hybrid RTGs at SSA Marine (Paul Gagnon & POLB)

- a. Discussion on cost effectiveness and emission reductions
  - i. SSA Marine presented the scope and results-to-date of its projects operating hybrid and battery-electric top handlers and RTGs at the Port of Long Beach (**Attachment D**). SSA's principle findings to date include:
    - Hybrid technology can be implemented much more quickly and cost-effectively and achieve much greater emission reductions in the immediate term and through 2045 than can grid-connected zero emission equipment.
    - Emissions reductions from the hybrid RTG exceeded SSA's initial estimates. Emission reductions are achieved by:
      - a. Replacing a 1,000 HP Tier 1 diesel engine in a standard RTG with a 142 HP Tier 4F diesel engine in the hybrid RTG.
      - b. A significant reduction in fuel use as the 1,000 HP diesel engine consumes 12 gallons of diesel per hour, whereas the 142 HP engine in the hybrid consumes 1.5 gallons of fuel per hour.
      - c. The steady-state mode of the engine serving as an electrical generator in the hybrid RTG allows it to operate very efficiently and cleanly.
      - d. The hybrid application allows the smaller, cleaner and more efficient diesel engine to operate only 46% of the time the RTG is running.





- In addition to significantly lower fuel costs, maintenance costs on hybrid RTGs are approximately 30% less than on conventional diesel RTGs, and oil change intervals move from 4x per year (diesel) to 2x per year (hybrid), in addition to the hybrid technology using significantly lower volumes of oil.
- The timeline and cost for implementing hybrid RTGs is significantly lower than full grid-connected zero emission RTGs. Comparing two similar SSA projects in Long Beach and Oakland, the Long Beach zero emission RTG project (9 units) will take approximately five years to implement at a cost of \$1.2M per RTG, and the Oakland project (13 units) will be implemented in approximately 2 years at a cost of \$450,000 per RTG. Infrastructure permitting and development timelines are the major source of delay; and the grid connected project requires that this be 100% completed before the first RTG can be deployed, whereas hybrid RTGs can be deployed upon delivery.
- SSA Marine observed that the high cost of battery-electric equipment prompts a conversation among terminal operators about the potential need for automation.
- SSA is also concerned with the local utility's ability to meet demand should the Port's full fleet of RTGs and top handlers be converted to run on grid electricity. With hundreds of pieces of CHE operating in the Port, the concern is the impact on the grid should all of this equipment need to be activated or charged at the same time – which is not unrealistic given the set operating hours of the Ports.
- SSA noted that the fully-electric Top Handlers it has begun operating are not performing per specification and only operating at half (and sometimes less than half) of the specified 2-shift/16-hour duty cycle that the marine terminal operator requires, while the hybrid alternatives have proven reliable and are able to fully operate for two shifts. SSA acknowledged that ongoing testing of new technology is important to its development.
- SSA engaged Starcrest Consulting to complete a cumulative emissions reduction analysis of their hybrid and plug-in electric RTG and top handler deployments. The analysis shows that the hybrid technology can achieve much greater aggregate emissions reductions through 2045. Results are driven by the near-term commercial availability and thus deployment opportunities for hybrid equipment, and the life-cycle emissions analysis which considers upstream emissions from the grid before it is fully renewable in 2045.



- Looking ahead, SSA Marine noted opportunities exist to further integrate other clean and renewable fuels/energy sources, including fuel cells, into the hybrid units in order to replace the diesel electrical generator achieve full zero emission operations.
  - While the immediate emission and cost benefits of hybrid technologies are significant, a challenge faced by SSA, and other terminal operators, is the risk of having a stranded asset should a hybrid RTG, top handler or other piece of equipment not be able to achieve a full zero emission status by the Ports' 2030 goal to have all zero emission CHE. In this instance, given the 20 to 25 year asset life of an RTG, there may be a hesitation to invest in the hybrid technology today, thus missing an opportunity for significant emission reductions through 2030. The Committee acknowledged the synergies and pathway for a hybrid RTG/top handle to be converted to full zero emissions, however, there is a need for additional technology development and demonstration to ensure this occurs.
  - The Committee requested further details on the total cost of ownership studies conducted under these projects to date. GNA agreed to collect this information from SSA Marine and subsequently share it with the Committee (**Attachment E**).
  - CARB observed that SSA's work and findings with this project would be valuable to the work of the Mobile Source Control Division and requested that this team connect with SSA Marine for further discussion.
- b. Recommendation opportunity
- i. The Committee discussed the significant economic and environmental opportunities of hybrid RTGs and top handlers, considerations with respect to the Clean Air Action Plan's 2030 zero emission CHE goals, and the need to continue to develop solutions to replace the diesel engine in the hybrid equipment with zero emission power generation technologies such a fuel cells.
    - GNA will develop a draft recommendation for the Committee's review that will focus on the increased deployment of hybrid technology in the immediate term in order to capture near-term emission reductions, while also allocating additional funding to continued RD&D so that the small diesel engine in the hybrid equipment could be replaced with a zero-emission technology (likely a fuel cell) in the future.
  - ii. Noting the strong results from the hybridized equipment, and the potential for significant impact across the Ports' RTG and top handler inventory, the Committee identified an opportunity to recommend



investments in this equipment to capture the immediate emissions reduction benefits, while creating a pathway to matured zero-emission equipment in the near- to mid-term.

- At the request of the Committee, the Ports agreed to identify funding sources that could support the Ports' adoption of and investments in hybrid as well as zero-emission top handler and RTG equipment.

#### 8. Discuss Committee Ideas for CTP Incentive Program Design

- a. The Ports summarized their respective Harbor Commission's responses to their presentation of the proposed Clean Truck Rate of \$10/TEU, in March, and noted that both boards had approved the rate. The ports are now developing their strategies for program implementation and will be conducting stakeholder outreach to capture feedback from the industry including financiers, manufacturers, and truck drivers and owners. The Ports will be presenting the results of this work to their boards in June.
- b. Under the CAAP, all trucks that are model year 2009 or older are required to shift to a 2014 model year standard. Committee members debated whether to apply CTP revenue to transition MY2010-2013 trucks to a cleaner alternative, or to focus on pre-2010 trucks and prevent them from shifting to used MY2014 or newer diesel trucks.
- c. The Ports requested that the Committee provide its feedback on the key parameters of the Clean Truck Incentive Program it is working to develop. As a follow up to the meeting, the Ports shared a list of key questions and issues with the Committee in advance of the May 2020 meeting in order that a productive dialogue and feedback session can result (**Attachment F**). The Ports are also looking for the Committee's thoughts on exemptions to the Clean Truck Rate as this was an item that the respective Harbor Commissions did not decide, beyond exemptions for zero emission trucks.

#### 9. Discussion and Input on May Roundtable on Clean Fueling Infrastructure

- a. Update and Discussion on the Clean Truck Rate (Ports)
  - i. This item was covered by the Ports as part of the discussion on item 8.
- b. Define goals and recommendation opportunity
  - i. The Committee discussed some of the key goals and objectives for a roundtable discussion amongst a range of external stakeholders (in the EV, fuel cell and RNG sectors) at the May meeting. The Committee agreed that a key question that they would like to answer in this roundtable is, what is the power capacity required by the Ports to meet their goals under the CAAP. This meeting will rely on a strong participation from utilities, component manufacturers (for EV charging and hydrogen fueling equipment) and fueling station providers.



- ii. To inform the conversation, before the next meeting, the Committee requested that GNA develop a short summary of the key issues for each of the fuel options, and basic background information on the external roundtable guests. GNA will develop and circulate this summary, together with the list of key questions the Ports would like to address with respect to the clean truck incentive program.
- iii. Reflecting on the utility of regular engagement, and the overall success of hosting the March Committee meeting online, Committee members suggested considering shifting from the bi-monthly meeting schedule to one that includes an interim check-in on key items, using online conferencing.

#### 10. Future Agenda Items

- a. Next SSCAC Meeting: May 20<sup>th</sup>, **Location TBD**
  - i. The meeting location will be determined as community and government responses to the outbreak of COVID-19 are clarified over the next several weeks.
- b. Agenda Topics:
  - i. Clean Truck Infrastructure Roundtable
  - ii. Deep Dive on CHE Pilot Projects (likely July)
  - iii. Mayoral Participation
    - Mayor Eric Garcetti's office confirmed that a scheduling request had been submitted, but advised that a timeline for confirmation would be unclear while social distancing measures were implemented and adjusted to mitigate the COVID-19 outbreak.
  - iv. CARB At-berth Rule update
    - The Committee agreed that a refreshed update would not be required, due to CARB's Board's adjusted schedule.

#### 11. Conclusion & Next Steps

- a. The Committee requested an update on the SSCAC website at the next meeting, or an interim update if it is launched beforehand. GNA confirmed that the website development is underway, and that it will notify the Committee when the website is launched.
- b. The Committee recognized Stephen Cadden's resignation, following the Coalition for Responsible Transportation's closure earlier that month. The group will consider suitable replacements to ensure that the trucking logistics sector has strong representation on the Committee.



## **Attachment D**

Meeting Presentation

# Sustainable Supply Chain Advisory Committee Meeting

May 20<sup>th</sup>, 2020



# Agenda

1. Online Meeting Protocol (GNA)
2. POLA / POLB Opening Remarks
3. Review and Approve March Meeting Summary
4. Review and Approve Committee Submissions
  1. Hybridization of RTGs and Top Handlers
  2. HMT Letter of Support & Proposed Recommendation
5. SCAQMD Facility-Based Mobile-Source Measures
6. Updates on CARB Regulatory Measures (CARB, CEC)
  1. Joint CARB/CEC ZE Drayage Truck RFP (\$40MM)
  2. Low NOx Omnibus Rule
  3. At-berth Rule
  4. Harbor Craft Rule
  5. eTRU Regulation
6. Next SSCAC Meeting
  1. July 15<sup>th</sup>, 2020, 11 am – 3 pm PDT
  2. Location TBD
7. Infrastructure Stakeholder Roundtable
  - a. Introduction & GoTo Webinar Protocol (GNA)
  - b. Overview of San Pedro Bay Port Drayage (GNA, Ports)
  - c. Facilitated Roundtable Discussion
    - a. Natural Gas
    - b. Hydrogen
    - c. Battery Electric
  - d. Opportunity for Committee Action
8. Conclusion and Next Steps



# GoTo Webinar Meeting Protocol

## Features and How to Use Them

Questions – submit a question to the Organizers

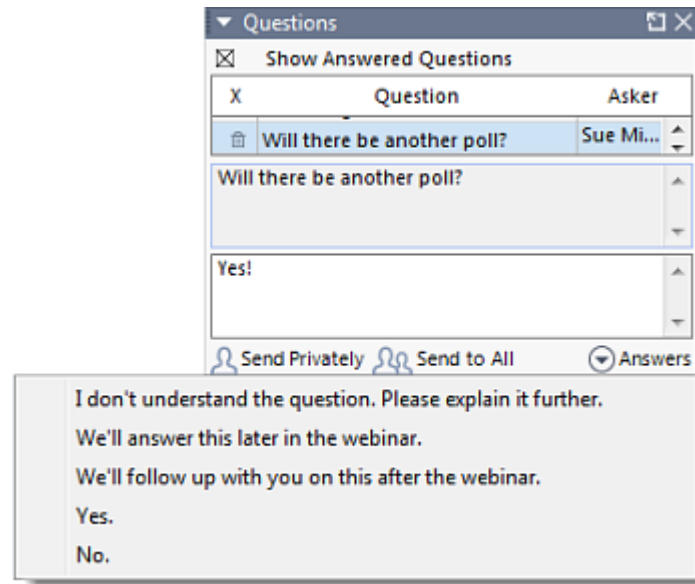
- State to whom the question is addressed; GNA Moderator will direct the question
- Use Chat feature to flag technical difficulties

Chat – submit comment to the Organizers Only

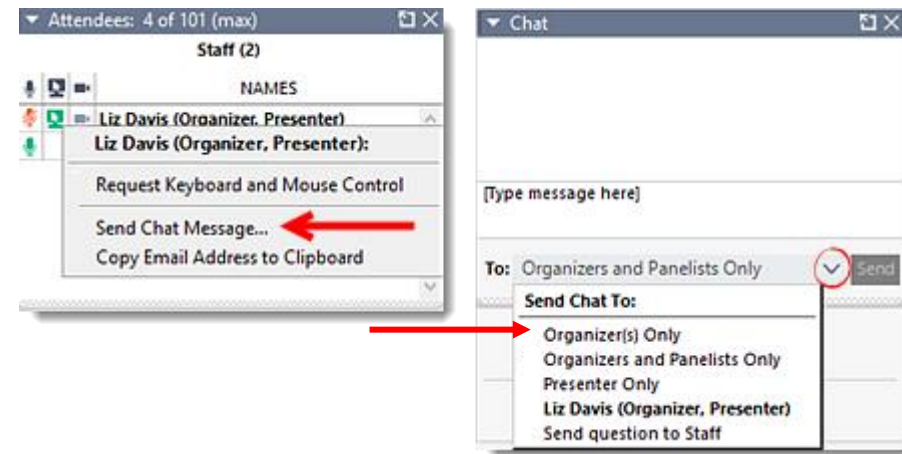
- State to whom the comment is addressed

Screenshare – GNA will manage screensharing

### *Using the Questions Feature*



### *Using the Chat Feature*



# GoTo Webinar Meeting Protocol

## Features and How to Use Them

Mute – As an attendee you are automatically muted when joining the session

- “Audience” members may be un-muted by GNA during scheduled presentation or discussion

Hand raise – “Audience” members may indicate if they would like to be un-muted

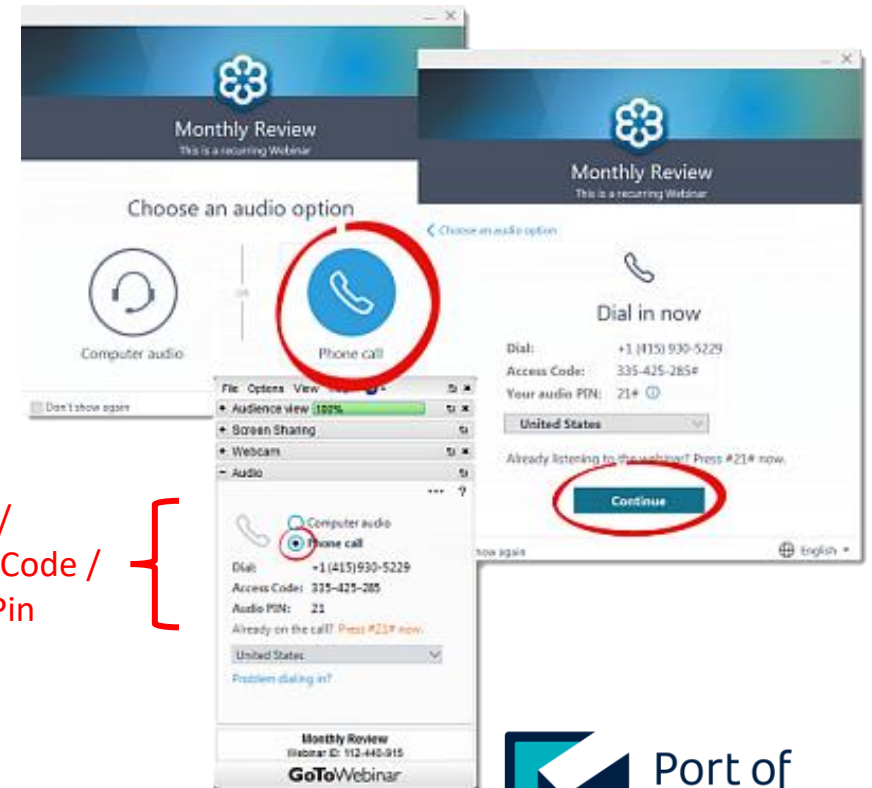


## Best practices:

Audio – You may connect to audio via your computer or via your phone.

- Phone is preferred for a better audio quality
- After logging in, locate the “Audio” section of the toolbar for the Dial-in Number, Access Code, & Audio Pin

Internet Connection – Using a wire connection (Ethernet cable) will provide the best quality connection



Dial-in /  
Access Code /  
Audio Pin

# Ports' Opening Remarks



# Discussion & Approval of Committee Documents

1. March Meeting Summary
2. Hybridization of RTGs and Top Handlers
3. HMT Letter of Support / Proposed Recommendation

# Updates on Regulatory Measures

## SCAQMD Update (Ian MacMillan)

1. Facility-based Mobile-Source Measures

## CARB / CEC Updates (Heather Arias, Sydney Vergis, Ben DeAlba)

1. Joint CARB/CEC ZE Drayage Truck RFP (\$40MM)
2. Low NOx Omnibus Rule
3. At-berth Rule
4. Harbor Craft Rule
5. eTRU Regulation

# Next SSCAC Meeting

- July 15<sup>th</sup>, 2020, 11 am – 3 pm PDT
- Location TBD

Sustainable Supply Chain Advisory Committee's  
Truck Fueling Infrastructure  
Roundtable

May 20<sup>th</sup>, 2020  
12:15 – 3 pm PDT





# GoTo Webinar Meeting Protocol

## Features and How to Use Them

Questions – submit a question to the Organizers

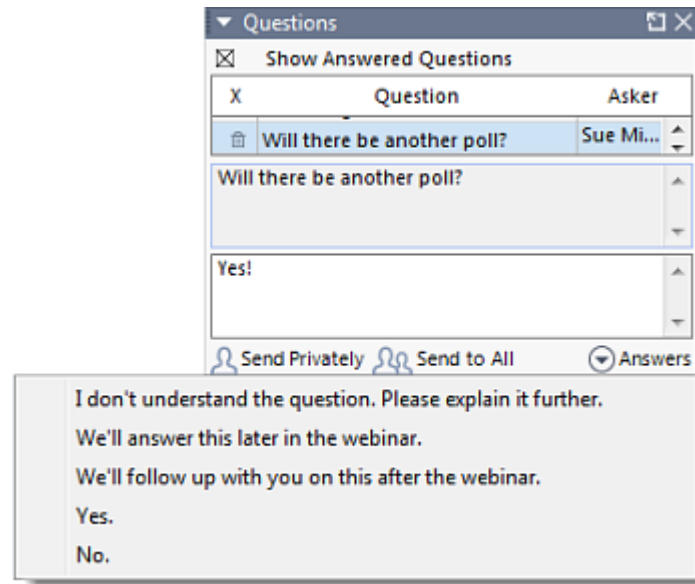
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Chat – submit comment to the Organizers Only

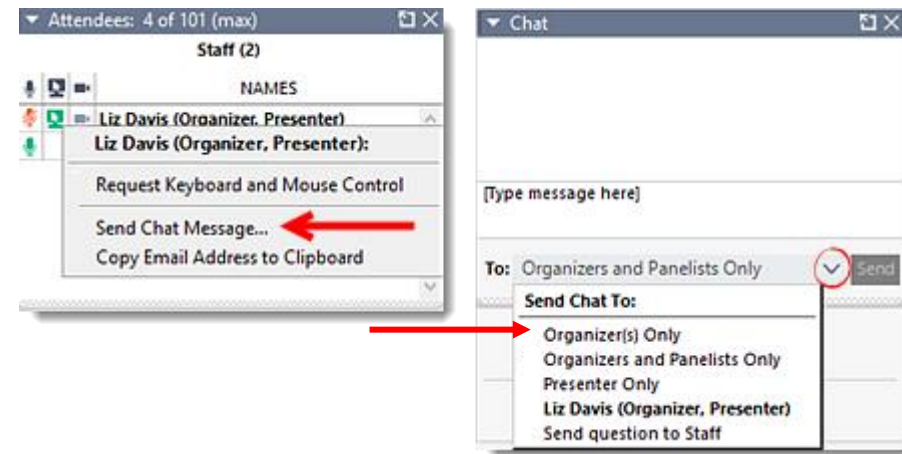
- State to whom the comment is addressed

Screenshare – GNA will manage screensharing

### *Using the Questions Feature*



### *Using the Chat Feature*



# GoTo Webinar Meeting Protocol

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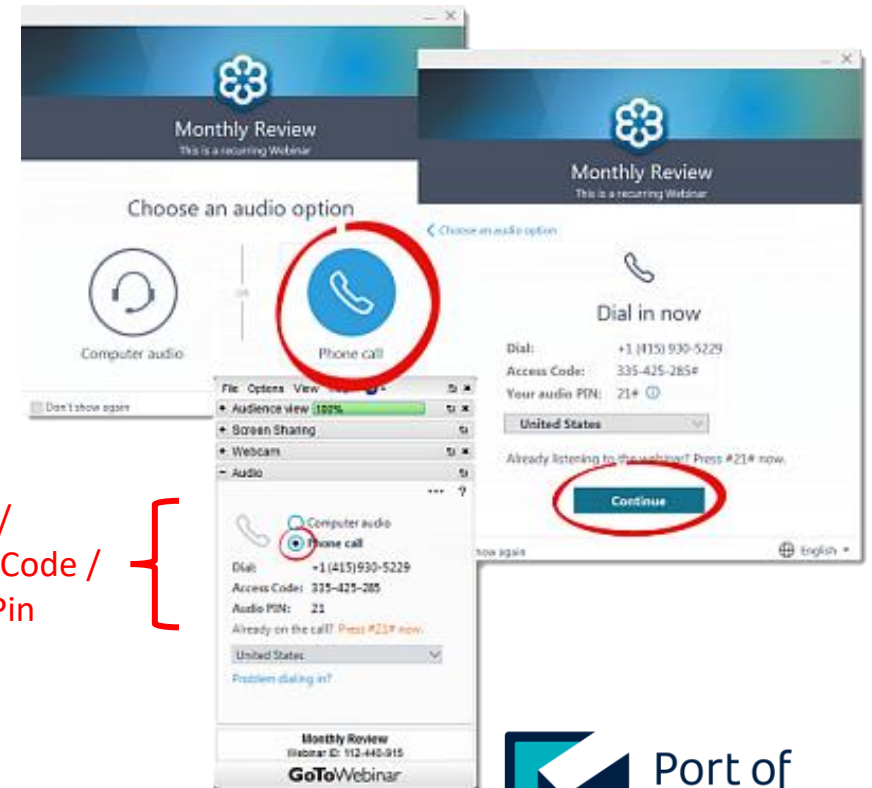


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# Introductions – SSCAC Members and Participants



Heather Arias  
CARB



Louis Dominguez  
San Pedro  
Neighborhood  
Council



Ray Familathe  
ILWU Local 13



Michele Grubbs  
PMSA  
Alt. Thomas Jelenic



Joe Lyou  
CCA and CTC



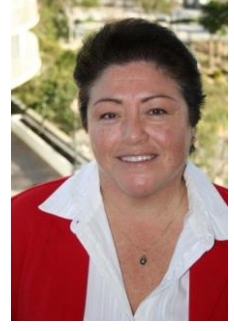
Adrian Martinez  
EarthJustice



Matt Miyasato  
SCAQMD



Marnie Primmer  
FuturePorts



Stella Ursua  
Green Education  
Inc.



Chris Cannon  
Port of Los  
Angeles

## Los Angeles Port Staff

Tim DeMoss  
Michael DiBernardo  
Jennifer Cohen  
Justin Houterman  
David Libatique  
Erick Martell

## Los Angeles City Staff

Irene Burga  
Jacob Haik  
David Reich  
Michael Samulon  
Lauren Faber O'Connor  
Max Reyes



Heather Tomley  
Port of Long  
Beach

## Long Beach Port Staff

Rick Cameron  
Morgan Caswell  
Wei Chi  
Sam Joumblat  
Eleanor Torres  
Bianca Villanueva

## Long Beach City Staff

Justin Ramirez  
Diana Tang

## SSCAC Supporting Participants

Bonnie Soriano, CARB  
Jessica Fahey, CARB  
  
Naveen Berry, SCAQMD  
Brian Choe, SCAQMD  
Zorik Pirveysian, SCAQMD

## SSCAC Facilitators

Erik Neandross, GNA  
Patrick Couch, GNA  
Alexis Wiley, GNA  
Eleanor Johnstone, GNA

# Introductions – Roundtable Speakers

Natural Gas		Hydrogen		Battery Electric	
<b>CleanEnergy</b>	Greg Roche, Vice President	<b>Air Liquide</b>	Charles Sanders, VP of Business Development Jordan Truitt, Manager of Business Development	<b>AMPLY</b>	Rob Kelly, VP of Business Development
<b>GAIN</b>	Scott Hanstedt, Director of Sales	<b>Air Products</b>	Christine Kretz, Manager of Business Development	<b>ChargePoint</b>	David Peterson, Director of Fleet Solutions
<b>SoCal Gas</b>	Kevin Maggay, Program Manager	<b>FuelCell Energy</b>	Paul Fukumoto, Director of Business Development	<b>Greenlots</b>	Lin-Zhuang Khoo, Senior VP Ashley Horvat, VP of Partnerships
<b>Shell</b>	Shawn Murphy, Engineering Manager	<b>Nikola</b>	Dale Prows, Head of Infrastructure Elizabeth Fretheim, Head of Business Development (National)	<b>LADWP</b>	Louis Ting, Director of Planning & Engineering
<b>Trillium</b>	Ryan Forrest, Western Region Manager	<b>Shell</b>	Wayne Leighty	<b>SCE</b>	Eric Seilo, Senior Manager Damon Hannaman, Senior Advisor
		<b>Trillium</b>	Ryan Forrest, Western Region Manager	<b>Tesla</b>	Noelani Derrickson, Business Development and Policy
				<b>Trillium</b>	Ryan Forrest, Western Region Manager

# Introductions – Roundtable Audience

## Roundtable Audience

<b>California Air Resources Board (CARB)</b>	David Quiros – Manager, Freight Technology Section
<b>California Energy Commission (CEC)</b>	Elizabeth John – Project Manager Michelle Vater – Supervisor, Freight & Transit Unit
<b>California Transportation Commission (CTC)</b>	Laura Pennebaker – Associate Deputy Director Hannah Walter – Trade Corridor Enhancement
<b>ChargePoint</b>	Clay Collier – Vice President, Energy Solutions
<b>Daimler Trucks North America</b>	Nate Hill – Team Lead, Charging Infrastructure
<b>Gateway Cities Council of Governments (GWCOG)</b>	Nancy Pfeffer – Executive Director
<b>Greenlots</b>	Idine Ghoreishian – Senior Manager
<b>SCAQMD</b>	Ray Gorski – Technical Advisor, Mobile Source Review Committee
<b>International Brotherhood of Electrical Workers (IBEW), Local Union 11</b>	Jennifer Kropke – Director of Environmental and Workforce Engagement
<b>Southern California Association of Government (SCAG)</b>	Annie Nam – Manager, Goods Movement and Transportation Finance Alison Linder – Senior Regional Planner

# Agenda

1. Housekeeping – GoTo Webinar
2. Overview - San Pedro Bay Port Foundations
  1. Manufacturer Perspectives
  2. Port Fleet Population & Behavior
  3. Port 2018 Drayage Truck Technical Feasibility Study
3. Facilitated Roundtable Discussion
  1. Natural Gas
  2. Hydrogen
  3. Battery Electric
4. Opportunity for Committee Action

# N/ZE Truck Manufacturer and Fleet Perspectives on Infrastructure (2017-2019)

*Between 2017 and 2019, the SSCAC convened truck manufacturers and fleets to discuss the development and deployment of N/ZE drayage trucks for the San Pedro Bay Ports. Their perspectives on the role of infrastructure in this work is generally summarized below and supported on the following two slides.*

**NGV production volumes are strong and infrastructure is moderately developed; both can be scaled to meet demand in the near term.**

*Meanwhile,*

**BEV production volumes are low and will remain limited until infrastructure solutions become more clearly defined for the customer. FCEV demonstrations have not yet begun for the port drayage segment.**



# NZE Truck Manufacturer and Fleet Perspectives on Infrastructure Availability

Manufacturers of NGVs are prepared to scale production to 8,000/yr over a 6-month period, and expect infrastructure will scale accordingly

- No limitation on natural gas production volumes is anticipated

Manufacturers of BEVs and FCEVs may have the capacity to scale production, but do not see clear customer demand because customers do not see clear fueling solutions. Progress in this area is hindered by:

- Lack of supply – the HD BEV and FCEV network is nascent, and both fueling industries' abilities to supply enough fuel and fueling equipment to support large-scale deployments is unclear.
- Lack of standardization - no standard has been defined, and, some interfaces are being sold without Nationally Recognized Testing Laboratory (e.g. UL) listing, creating a higher perceived risk of disruption during construction/commissioning.
- Lack of clear process and timeline – infrastructure development requires multiple parties whose actions are limited by a lack of standardized and clearly accepted market practices.

Appropriate applications of BEV and FCEV are undefined

- How will these two fuel-technology architectures be used in the larger trucking market?
- What balance of public/private, fast/slow fueling infrastructure will best meet needs in these applications?



# ZE Truck Manufacturer and Fleet Perspectives on Infrastructure Cost

## Cost of fueling is unpredictable, mitigating customer appetite for BEV technologies

- Electricity rate structures are inconsistent across large territories
- Electricity rates vary by time of day, and season
- Fast-fueling can have unpredictably high costs

## Funding is available but often poorly aligned and from diverse sources

- Funding for infrastructure and funding for vehicles are often not available from the same sources
- Customers often have to cobble together funds from disparate sources to cover project costs

## Funding terms are restrictive

- The relationship between funding, charging standards, and NRTL listing restricts what infrastructure a fleet can purchase, in turn restricting what vehicles it can purchase
- These terms can limit the project scope and scale

# Port Drayage Fleet Population and Behavior

## Population: 17,471 Class 8 Drayage trucks total

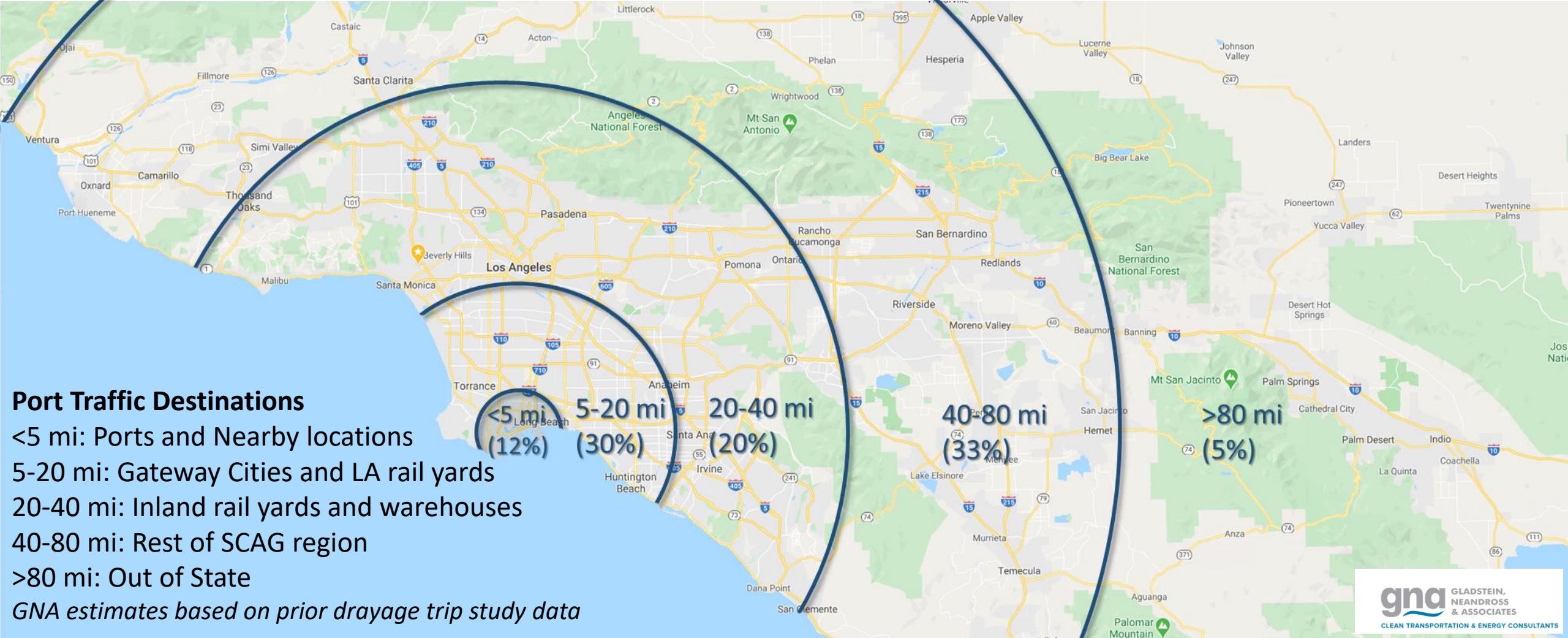
- 12,845 active (73% of total population)
  - MY'07-'09: 5,187
  - MY'10-'13: 3,765
  - MY'14+: 3,983
- 95% Diesel – 4% Natural Gas – 1% Other
- ~67% LMCs have small (<20 unit) fleets
- Majority of trucks driven by IOOs

## San Pedro Bay Port Clean Truck Incentive Program

- A \$10/TEU rate may be assessed on non-ZE trucks beginning in Q3 2020, pending confirmation from the respective Harbor Commissions.
- Revenue (est. \$90MM/year) to support the adoption of clean trucks by port drayage operators
- Terms of using the revenue for a program incentive to buy clean trucks are currently under consideration

## Port Truck Critical Compliance Targets

- 2020: MY2014 required for new port truck registrations; ZE are rate-exempt
- 2023: MY2010 or newer required to remain in truck registry; NZE or better required for new truck registration
- 2035: 100% ZE drayage truck goal



# Port Drayage Fleet's Estimated Infrastructure Needs

## 2018 Feasibility Assessment

- Considered fleet size of 11,000 and 18,000 trucks
- Estimated 42% of fleet has space for on-site fueling/charging infrastructure
- 58% of fleet would require public access fueling/charging infrastructure
- Public access infrastructure is critical to current drayage fleet
  - NGV: 9-14 large stations
  - EV: 1,200-2,000 charging stalls for multi-hour charge sessions
  - FCV: 100-175 stations at 1,500 kg/day capacity per station

Estimated AFV Fuel Demands (Source: 2018 SPBP Drayage Truck Technical Feasibility Study)

Fueling Station Type / Location	11,000 Truck Fleet	18,000 Truck Fleet
<b>On-site Stations – Daily Energy Throughput</b>		
Trucks Served	4,620	7,560
Natural Gas	215,600 DGE	352,800 DGE
Electricity	2.75 GWh	4.50 GWh
Hydrogen	114,400 kg	187,300 kg
<b>Public Stations – Daily Energy Throughput</b>		
Trucks Served	6,380	10,440
Natural Gas	297,700 DGE	487,200 DGE
Electricity	3.80 GWh	6.21 GWh
Hydrogen	158,000 kg	258,600 kg
<b>Total Daily Energy Throughput</b>		
Natural Gas	<b>513,000 DGE</b>	<b>840,000 DGE</b>
Electricity	<b>6.55 GWh</b>	<b>10.71 GWh</b>
Hydrogen*	<b>272,400 kg</b>	<b>445,900 kg</b>

**Context for 11,000 Truck Fuel and Infrastructure Needs Estimates:**

513,000 DGE natural gas = 3% SCG average daily delivery; 16 large (10-lane) fueling stations  
 6.55 GWh = 2% LADWP+SCE average daily sales; 2.7x Tesla global Supercharger network  
 272,400 kg H2 = 1% of US average daily production; 22x CA fueling station network

\*Hydrogen values not included in Feasibility Study, but are estimated here using LCFS Program EER values



# Ports' Drayage Truck Technical Feasibility Study (2018) – Overall Findings

Basis for determining  
“Technical Feasibility”

Feasibility Parameter / Criteria	Overall Achievement* of Criteria in 2018 (Commercially Available / Technically Viable Truck Platforms)	
	ZE Battery-Electric	NZE NG ICE
Commercial Availability		
Technical Viability	TRL 6 to 7 (moving to 7 or 8)	TRL 9
Operational Feasibility		
Infrastructure Availability		
Economic Workability		

**Legend: Achievement of Each Noted Parameter / Criteria (2018)**

Little/No Achievement
 


 Fully Achieved

\*These ratings for overall achievement of each five feasibility parameters are based on the analysis of several criteria within that parameter. Because each criterion is important for the success of a given fuel-technology platform in drayage, the overall achievement ratings are based on the lowest criterion score for each feasibility parameter.

**Infrastructure Availability is one of/the area needing the most improvement for NGVs and BEVs.**

**TRL Rankings Explained:**

BEV Trucks

- Currently “Fully integrated prototypes tested in a relevant environment” and “System prototype in an operational environment”
- Moving towards “Commercial demonstration, full scale deployment in final form”

NGV Trucks

- Currently in “Commercial demonstration, full scale deployment in final form”
- Moving towards “Commercial operation in a relevant environment”



# Ports' Drayage Truck Technical Feasibility Study (2018) – Drayage Truck Infrastructure Findings

Infrastructure Criteria / Parameter	Base Considerations for Assessing Infrastructure Availability	Achievement of Criteria for Remaining Drayage Truck Platforms	
		ZE Battery-Electric	NZE NG ICE
Dwell Time at Station	Refueling/recharging can be accommodated within typical work breaks, lunches, other downtime compatible with trucking company schedules and operational needs.		
Station Location and Footprint	Fleets have existing onsite access to fueling infrastructure, or can be fueled/charged conveniently and affordably off site, at public or private stations. New infrastructure can be installed without extensive redesign, reconfiguration or operational disruptions and there is sufficient electrical or natural gas capacity at the site.		
<b>Infrastructure Buildout</b>	Infrastructure can be constructed at a pace consistent with fleet adoption and able to meet fleet fueling/charging requirements by the end of the assessment period.		
Existence of / Compatibility with Standards	A sufficient body of codes and standards exist from appropriate organizations that enables safe and effective refueling/recharging. The refueling/recharging station technology has already been installed at other trucking companies in the U.S., with sufficient time to assess performance and safety.		
<b>Legend: Infrastructure Availability (2018)</b> 			
<b>Source:</b> based on preliminary OEM survey responses, OEM product information, various government sources, and Tetra Tech team's industry knowledge.			

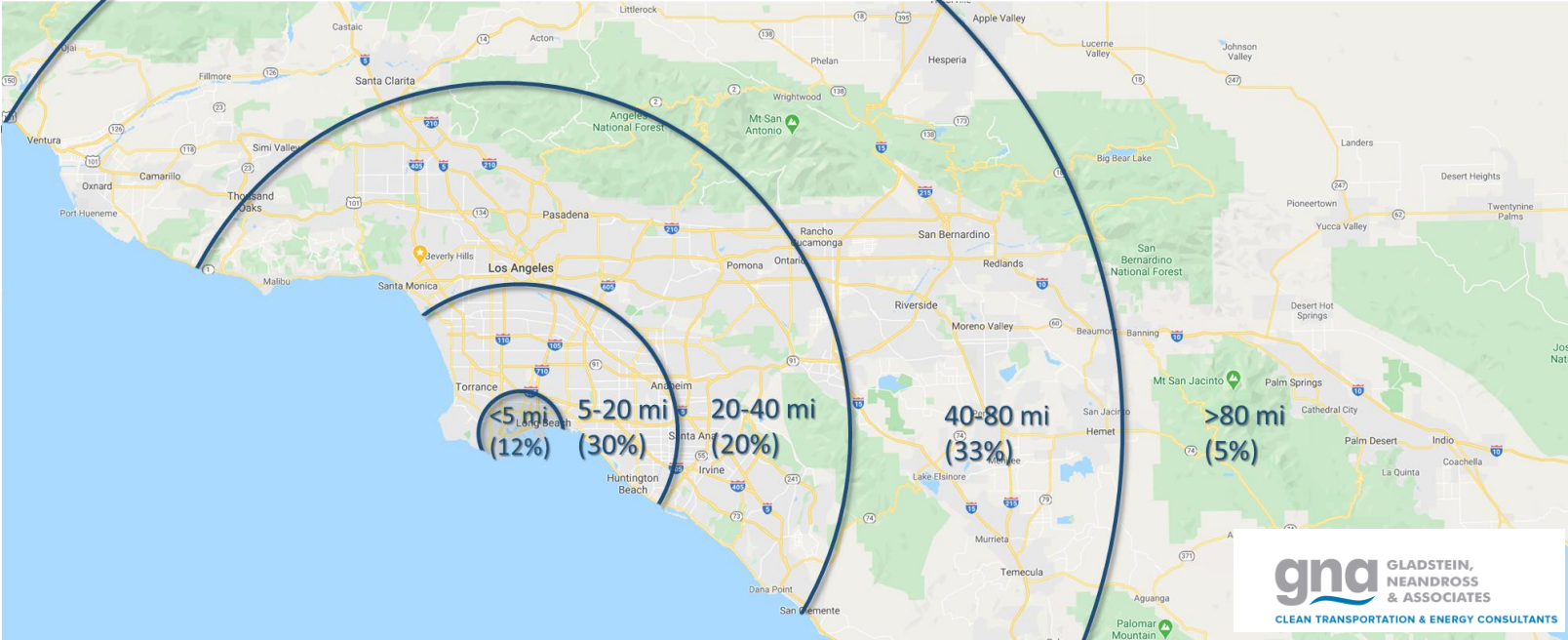
**Infrastructure Buildout is one of/the area needing the most improvement for NGVs and BEVs.**

Today, the majority of port drayage truck drivers rely on public fueling infrastructure located off of port property. The ports are not anticipating this to shift with the transition to N/ZE technologies.

Additionally, most truck depots have limited available space.

# Discussion – Overarching Question

What does the ports’ goal of “transitioning the current drayage truck fleet to a near-zero and ultimately zero emissions drayage trucking fleet by 2035” mean for building out the fueling infrastructure in the harbor and throughout the region to support the transition of this 11,000 to 18,000 truck fleet?



Fuel	11,000 Truck Fleet Daily Throughput
Natural Gas	513,000 DGE
Electricity	6.55 GWh
Hydrogen	272,400 kg



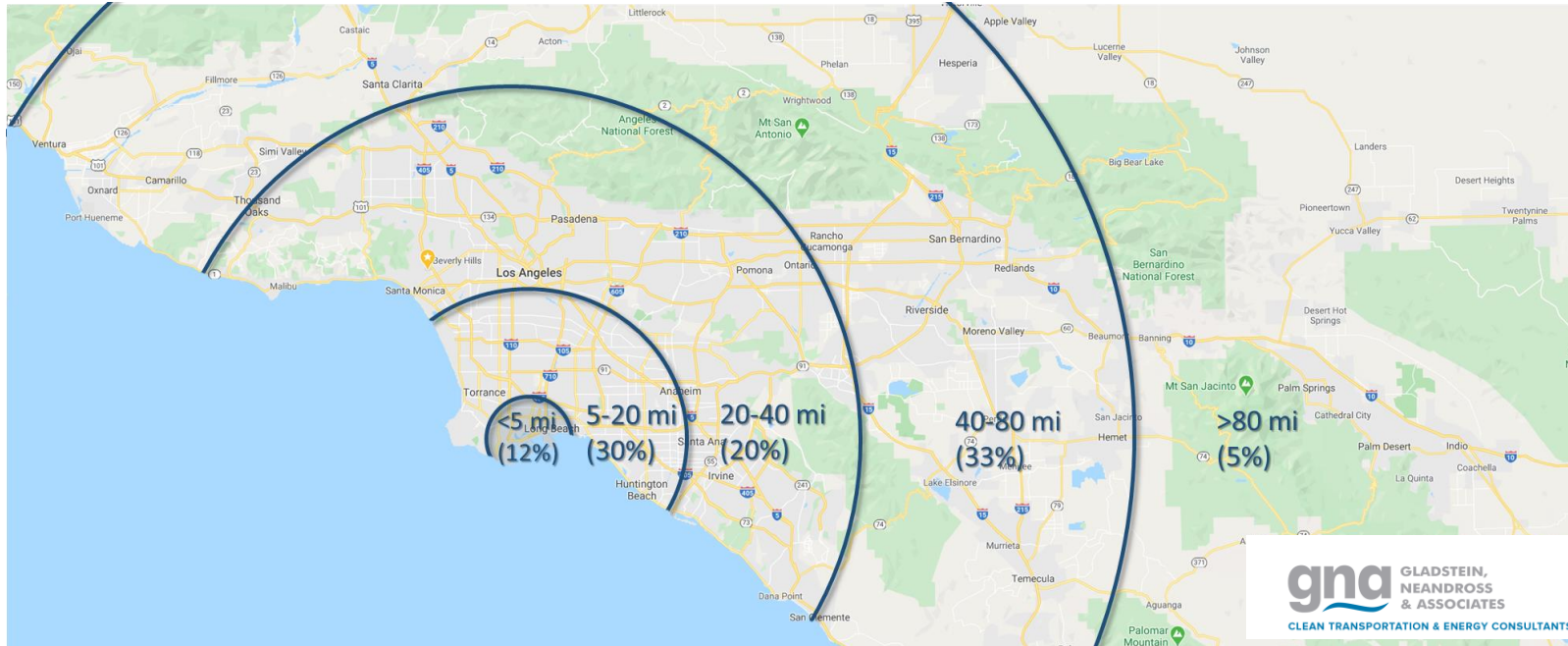
# Discussion Questions

1. What is your vision for the development of the fueling infrastructure – for your fuel – to meet the needs of 12,000 to 18,000 drayage trucks operating within the harbor and throughout Southern California, and considering that approximately 60% of these trucks require public fueling? How does this vision unfold? When and how does it happen? And what is required to make it a reality?
2. What does a centralized public fueling station look like in terms of space and dwell time accommodations? How long can you refuel a truck? Is the technology now market ready? If not, when will it be ready to deploy this kind of infrastructure?
3. How many public sites do you think are required to meet the needs of the port drayage truck market, and do you have a sense of where within the region they would be located? What is your opinion about the real estate needed to site these stations?
4. Where does the capital come from to pay for this infrastructure? Does this have to be paid for with public incentives? How much private capital can be used here? How does private vs public capital ultimately impact the price of fuel to the end user?
5. How realistic is this vision?
6. What signals from the vehicle market are most important to your decision to begin building out to the level required to meet port drayage demand?
7. What is involved to ramp up infrastructure to the level expected to meet Port fleet needs?
  1. What is the estimated time frame for this ramping effort? When do you need to get started, and when do you really see the critical period of time for a ramp in infrastructure development?
  2. What are likely to be the greatest constraints to deploying this scale of infrastructure?
  3. What economies of scale are achievable, both in terms of cost and time?
8. How much fuel can be supplied on a daily basis under current conditions?
  1. Where is it/will it be produced?
  2. What transmission/distribution infrastructure is available today, and what additional infrastructure will be needed to meet demand in the San Pedro Bay Ports?
9. What is your industry's target fuel price range, inclusive of the infrastructure, in 2025? 2030? And, what variations on this price range may exist for fleets?
10. What percent of your fuel will be renewable by 2030? 2035? How does integrating renewables affect your forecasted supply and infrastructure build-out schedule and costs?



# Natural Gas

What does the ports' goal of "transitioning the current drayage truck fleet to a near-zero and ultimately zero emissions drayage trucking fleet by 2035" mean for building out the fueling infrastructure in the harbor and throughout the region to support the transition of this 11,000 to 18,000 truck fleet?

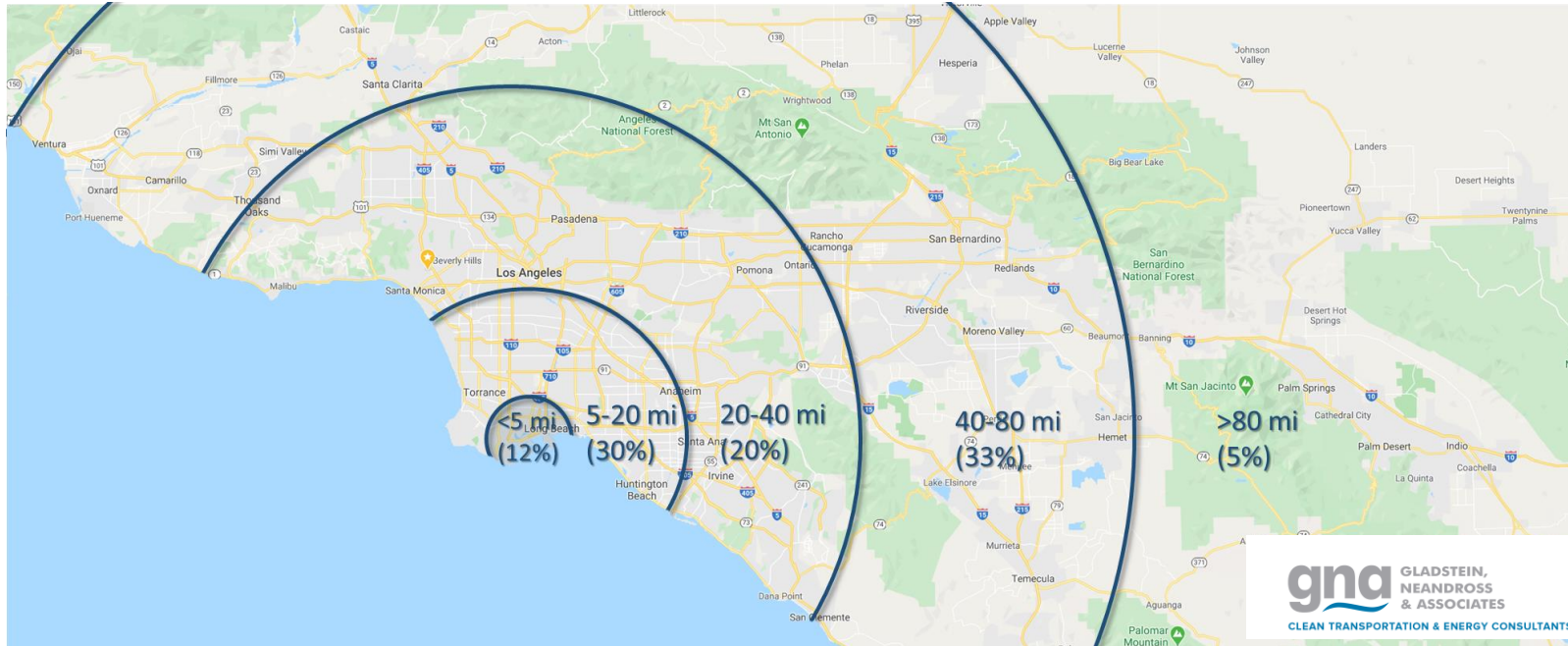


Speakers	
<b>CleanEnergy</b>	Greg Roche
<b>GAIN</b>	Scott Hanstedt
<b>Shell</b>	Shawn Murphy
<b>SoCal Gas</b>	Kevin Maggay
<b>Trillium</b>	Ryan Forrest

Fuel	11,000 Truck Fleet Daily Throughput
<b>Natural Gas</b>	513,000 DGE
<b>Electricity</b>	6.55 GWh
<b>Hydrogen</b>	272,400 kg

# Hydrogen

What does the ports' goal of "transitioning the current drayage truck fleet to a near-zero and ultimately zero emissions drayage trucking fleet by 2035" mean for building out the fueling infrastructure in the harbor and throughout the region to support the transition of this 11,000 to 18,000 truck fleet?



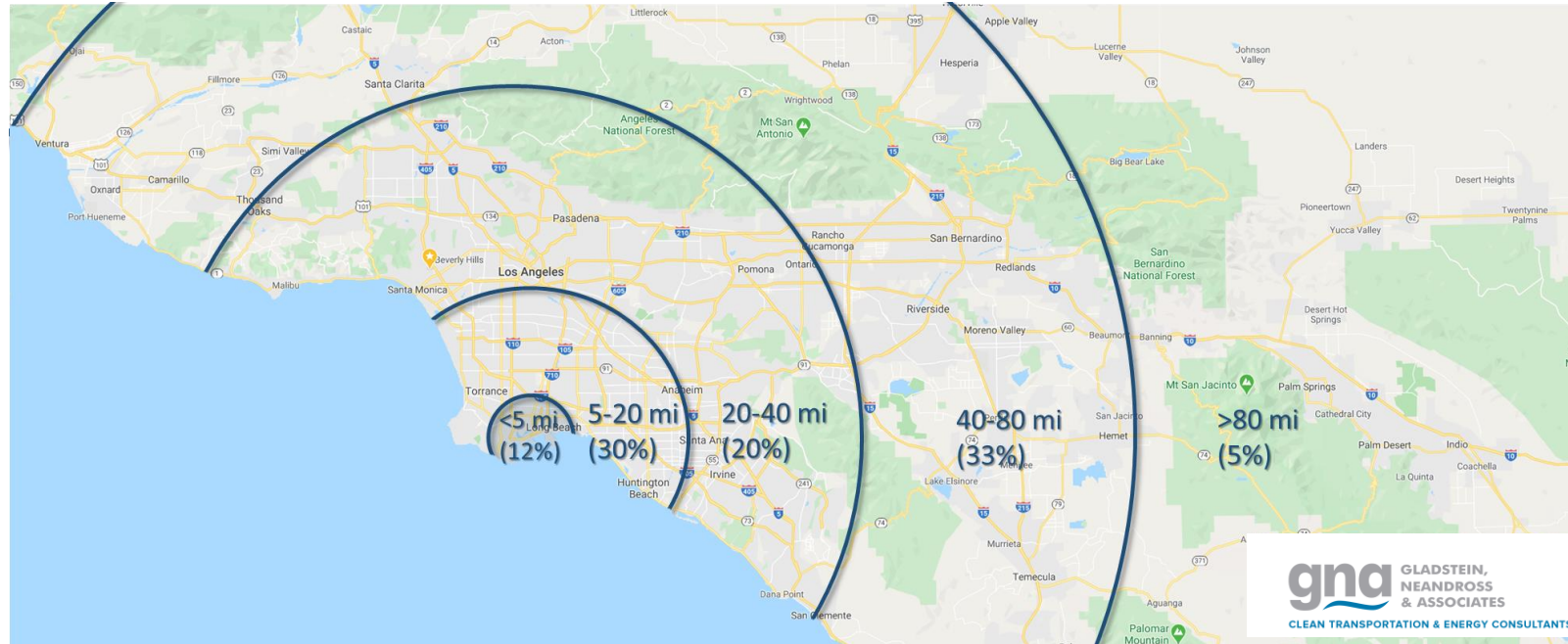
Speakers	
<b>Air Liquide</b>	Charles Sanders Jordan Truitt
<b>Air Products</b>	Christine Kretz
<b>FuelCell Energy</b>	Paul Fukumoto
<b>Nikola</b>	Elizabeth Fretheim Dale Prows
<b>Shell</b>	Wayne Leighty
<b>Trillium</b>	Ryan Forrest

Fuel	11,000 Truck Fleet Daily Throughput
<b>Natural Gas</b>	513,000 DGE
<b>Electricity</b>	6.55 GWh
<b>Hydrogen</b>	272,400 kg



# Battery Electric

What does the ports' goal of "transitioning the current drayage truck fleet to a near-zero and ultimately zero emissions drayage trucking fleet by 2035" mean for building out the fueling infrastructure in the harbor and throughout the region to support the transition of this 11,000 to 18,000 truck fleet?



Speakers	
<b>AMPLY</b>	Rob Kelly
<b>ChargePoint</b>	David Peterson
<b>Greenlots</b>	Lin-Zhuang Khoo Ashley Horvat
<b>LADWP</b>	Louis Ting
<b>SCE</b>	Eric Seilo Damon Hannaman
<b>Tesla</b>	Noelani Derrickson
<b>Trillium</b>	Ryan Forrest

Fuel	11,000 Truck Fleet Daily Throughput
<b>Natural Gas</b>	513,000 DGE
<b>Electricity</b>	6.55 GWh
<b>Hydrogen</b>	272,400 kg



# Committee Closing Comments



Thank you to our Guests!





## **Attachment E**

Infrastructure Roundtable Primer - Committee





## San Pedro Bay Ports

### Sustainable Supply Chain Advisory Committee's

## Truck Fueling Infrastructure Roundtable - Primer

May 20<sup>th</sup>, 2020

### Roundtable's Overarching Question:

The overarching question for the roundtable discussion is:

*What does the ports' goal of "transitioning the current drayage truck fleet to a near-zero and ultimately zero emissions drayage trucking fleet by 2035" mean for building out the fueling infrastructure in the harbor and throughout the region to support this transition of this 12,000 to 18,000 truck fleet?*

We have invited select guests that represent companies involved in the fueling of natural gas, hydrogen and battery electric trucks. A list of these guests is included at the end of this document with a summary of their companies' roles in this space. We will work through each fuel type separately, with each one getting 45 min to an hour of time with the Committee. At the start of each fuel-focused session, we will ask each guest from that fuel group to provide an introduction and some general remarks on these issues in general; opening comments should be about 2 or 3 minutes at most. A moderated discussion with the Committee will then follow using the below discussion questions as a general guide.

### Discussion Questions

The following questions have been prepared and shared with the invited guests in advance of the meeting. These questions are meant to serve as prep and thought starters. We are not planning to use this list of questions to survey or poll everyone in the meeting.

1. What is your vision for the development of the fueling infrastructure – for your fuel – to meet the needs of 12,000 to 18,000 drayage trucks operating within the harbor and throughout Southern California, and considering that approximately 60% of these trucks require public fueling? How does this vision unfold? When and how does it happen? And what is required to make it a reality?
2. What does a centralized public fueling station look like in terms of space and dwell time accommodations? How long can you refuel a truck? Is the technology now market ready? If not, when will it be ready to deploy this kind of infrastructure?
3. How many public sites do you think are required to meet the needs of the port drayage truck market, and do you have a sense of where within the region they would be located? What is your opinion about the real estate needed to site these stations?
4. Where does the capital come from to pay for this infrastructure? Does this have to be paid for with public incentives? How much private capital can be used here? How does private vs public capital ultimately affect the price of fuel to the end user?



5. How realistic is this vision?
6. What signals from the vehicle market are most important to your decision to begin building out to the level required to meet port drayage demand?
7. What is involved to ramp up infrastructure to the level expected to meet Port fleet needs?
  - a. What is the estimated time frame for this ramping effort? When do you need to get started, and when do you really see the critical period of time for a ramp in infrastructure development?
  - b. What are likely to be the greatest constraints to deploying this scale of infrastructure?
  - c. What economies of scale are achievable, both in terms of cost and time?
8. How much fuel can be supplied on a daily basis under current conditions?
  - a. Where is it/will it be produced?
  - b. What transmission/distribution infrastructure is available today, and what additional infrastructure will be needed to meet demand in the San Pedro Bay Ports?
9. What is your industry's target fuel price range, inclusive of the infrastructure, in 2025? 2030? And, what variations on this price range may exist for fleets?
10. What percent of your fuel will be renewable by 2030? 2035? How does integrating renewables affect your forecasted supply and infrastructure build-out schedule and costs?





Summary of Roundtable Participant Organizations

<b>Battery Electric</b>			
<b>Company</b>	<b>Guests</b>	<b>Summary</b>	<b>For More Information</b>
<i>Fuel Providers</i>			
LADWP	Louis Ting	Publicly-owned water and power utility serving Los Angeles county. LADWP's Charge Up LA! Program offers \$1.5MM in rebates for medium- and heavy duty EV charging stations. Rebate amounts start at \$10,000 for 6-49 kW stations and go up to \$125,000 for 150kW+ stations. The program is currently open for enrollment, and \$1.4MM is marked as reserved.	<a href="#">Commercial EV Charging Station Rebate Program</a>
SCE	Damon Hannaman	Investor-owned power utility serving several counties across Southern California. Charge Ready Transport program offers low to no cost EV charging infrastructure installation, rebates on charging stations for certain types of businesses, EV-specific power pricing schedules, and waived customer demand charges through 2024. Requirements include the lease, purchase or conversion of at least 2 EVs, and a grant of easement from the property owner.	<a href="#">Charge Read Transport Program</a>
<i>EV Charging Station Providers</i>			
AMPLY	Rob Kelly	Provider of turnkey charging-as-a-service (CaaS) solutions to help fleets manage their EV charging schedules and costs and reduce charging costs. AMPLY is a preferred provider of BYD, has worked with several transit and school bus fleets, and recently secured \$13.2MM in funding to develop its services for commercial fleets.	<a href="#">AMPLY Services</a>
ChargePoint	David Peterson	A leading provider of EV charging stations (Level 2 and DCFC) which has recently rolled out services tailored to commercial fleets. ChargePoint sells the station hardware as well as charging management software.	<a href="#">ChargePoint Commercial Fleet Solutions</a>
Greenlots	Lin-Zhuang Khoo Ashley Hoorvat	A member of the Shell company, and partner on the Volvo LIGHTS project, Greenlots provides EV charging hardware and software designed to optimize fleet performance and reduce charging costs.	<a href="#">Greenlots' Fleet Charging Services</a>



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Trillium	Ryan Forrest	A Love's company, Trillium designs, builds and operates alternative fueling stations for natural gas, hydrogen and battery electric vehicles. It also produces renewable variations of these three fuel types.	<a href="#">Trillium</a>
Tesla	Noelani Derrickson	Producer of battery electric passenger cars with a Class 8 truck scheduled to go into production in 2021, and, a provider of electricity storage and EV charging solutions at multiple power levels. Tesla operates supercharger networks across the U.S., Europe and Asia.	<a href="#">Tesla Charging</a>



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<b>Hydrogen Fuel Cell</b>			
<b>Company</b>	<b>Guests</b>	<b>Summary</b>	<b>For More Information</b>
<i>Fuel Providers</i>			
Fuel Cell Energy	Paul Fukumoto	Global provider of hydrogen fuel cell-based systems supporting a range of applications including on-site energy generation, long-term energy storage, and local hydrogen production for transportation.	<a href="#">Fuel Cell Energy's Services</a>
Shell	Wayne Leighty	Global energy major selling hydrogen at vehicle fueling stations in Europe and North America. Shell is a partner in the development of three new large-capacity fueling stations for FCEV trucks developed by Kenworth and Toyota for the Port of Los Angeles; one station is designed to use biogas to produce renewable hydrogen. Shell has a goal of achieving net zero GHG emissions by 2050.	<a href="#">Shell's hydrogen study</a>
<i>Hydrogen Fueling Station Providers</i>			
Air Liquide	Charles Sanders Jordan Truitt	Global fuel and technology solutions provider which has designed and built over 100 hydrogen vehicle fueling stations since 2012. Air Liquide is currently building a 30 ton/day renewable hydrogen production plan in Nevada to serve anticipated demand in the Western U.S., particularly in California.	<a href="#">Air Liquide – Hydrogen solutions</a>
Air Products	Christine Kretz	Global fuel and technology solutions provider that has participated in several projects to develop on-road vehicle hydrogen fueling stations. Air Products recently partnered with Trillium to develop the largest hydrogen fueling station for transit buses, for OCTA, under a California Climate Investments project with CTE; the station opened in January 2020.	<a href="#">Air Products – Hydrogen fuel for Transportation</a>
Nikola	Elizabeth Fretheim Dale Prows	New zero-emission vehicle manufacturer developing 700 commercial fleet-scale hydrogen fueling stations across the US by 2028. Nikola has partnered with technology provider NEL on its station development plans.	<a href="#">Nikola's station plans</a>
Trillium	Ryan Forrest	A Love's company, Trillium designs, builds and operates alternative fueling stations for natural gas, hydrogen and battery electric vehicles. It also produces renewable variations of these three fuel types.	<a href="#">Trillium</a>



<b>Natural Gas</b>			
<b>Company</b>	<b>Guests</b>	<b>Summary</b>	<b>For More Information</b>
<i>Fuel Providers</i>			
Shell	Shawn Murphy	Global energy major producing and selling natural gas at vehicle fueling stations globally, including several Shell LNG and CNG fuel stations and a large renewable natural gas portfolio in California. Shell has a goal of achieving net zero GHG emissions by 2050.	<a href="#">Shell's work with Natural Gas</a>
SoCal Gas	Kevin Maggay	Investor-owned utility providing natural and renewable gas service, and with a history of partnering with truck and engine manufacturers to develop near-zero technologies and fueling solutions.	<a href="#">SoCal Gas' clean technology investments</a>
CleanEnergy	Greg Roche	National provider of renewable as well as fossil natural gas for fleets, and designer and developer of natural gas fueling stations. CleanEnergy manages over 500 fast-fill fueling stations across the U.S., and recently partnered with CWI to demonstrate the Cummins ISX12N with renewable RNG in a goods movement duty cycle, under a project funded by CARB, the CEC, and SCAQMD.	<a href="#">CleanEnergy's Natural Gas Products</a>
<i>Natural Gas Fueling Station Providers</i>			
GAIN	Scott Handstedt	Leading developer of compressed and renewable natural gas projects and fueling station solutions suited for diverse on-road fleet types. GAIN has developed natural gas fueling stations across the country that are suited to heavy-duty trucking fleets.	<a href="#">GAIN's solutions for goods movement</a>
Trillium	Ryan Forrest	A Love's company, Trillium designs, builds and operates alternative fueling stations for natural gas, hydrogen and battery electric vehicles. It also produces renewable variations of these three fuel types. Combined, Love's Travel Stops and Trillium own 65 public-access CNG facilities.	<a href="#">Trillium's Heavy Duty CNG fleet fueling solutions</a>



## **Attachment F**

Infrastructure Roundtable Primer - Speakers



## San Pedro Bay Ports

### Sustainable Supply Chain Advisory Committee's

## Truck Fueling Infrastructure Roundtable - Primer

May 20<sup>th</sup>, 2020 | 12:15 pm – 3 pm Pacific

### Agenda

1. Introductions & GoTo Webinar Protocol (GNA)
  - a. Q&A, Screen Sharing, Mute, Video
2. Presentation of Port Drayage Fleet Energy Needs and Influencing Factors (GNA, Ports)
3. Facilitated Roundtable Discussion
  - a. Natural Gas
  - b. Battery Electric
  - c. Hydrogen
4. Opportunity for Committee Action

### Roundtable's Overarching Question:

The overarching question for the roundtable discussion is:

*What does the ports' goal of "transitioning the current drayage truck fleet to a near-zero and ultimately zero emissions drayage trucking fleet by 2035" mean for building out the fueling infrastructure in the harbor and throughout the region to support this transition of this 12,000 to 18,000 truck fleet?*

We have invited select guests that represent companies involved in the fueling of natural gas, hydrogen and battery electric trucks. After some introductory remarks and background on port drayage trucking, we will work through each fuel type separately, with each one getting 45 min to an hour of time with the Committee. At the start of each fuel-focused session, we will ask each guest from that fuel group to provide an introduction and some general remarks on these issues in general; opening comments should be about 2 or 3 minutes at most. A moderated discussion with the Committee will then follow using the below discussion questions as a general guide.

### Discussion Questions

The following questions have been prepared as thought starters. We are not planning to use this list of questions to survey or poll everyone in the meeting. They are simply meant to provide a preview and general guide to the key issues we'd like to explore with each group.

1. What is your vision for the development of the fueling infrastructure – for your fuel – to meet the needs of 12,000 to 18,000 drayage trucks operating within the harbor and



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throughout Southern California, and considering that approximately 60% of these trucks require public fueling? How does this vision unfold? When and how does it happen? And what is required to make it a reality?

2. What does a centralized public fueling station look like in terms of space and dwell time accommodations? How long can you refuel a truck? Is the technology now market ready? If not, when will it be ready to deploy this kind of infrastructure?
3. How many public sites do you think are required to meet the needs of the port drayage truck market, and do you have a sense of where within the region they would be located? What is your opinion about the real estate needed to site these stations?
4. Where does the capital come from to pay for this infrastructure? Does this have to be paid for with public incentives? How much private capital can be used here? How does private vs public capital ultimately impact the price of fuel to the end user?
5. How realistic is this vision?
6. What signals from the vehicle market are most important to your decision to begin building out to the level required to meet port drayage demand?
7. What is involved to ramp up infrastructure to the level expected to meet Port fleet needs?
  - a. What is the estimated time frame for this ramping effort? When do you need to get started, and when do you really see the critical period of time for a ramp in infrastructure development?
  - b. What are likely to be the greatest constraints to deploying this scale of infrastructure?
  - c. What economies of scale are achievable, both in terms of cost and time?
8. How much fuel can be supplied on a daily basis under current conditions?
  - a. Where is it/will it be produced?
  - b. What transmission/distribution infrastructure is available today, and what additional infrastructure will be needed to meet demand in the San Pedro Bay Ports?
9. What is your industry's target fuel price range, inclusive of the infrastructure, in 2025? 2030? And, what variations on this price range may exist for fleets?
10. What percent of your fuel will be renewable by 2030? 2035? How does integrating renewables affect your forecasted supply and infrastructure build-out schedule and costs?



## **Attachment G**

Infrastructure Roundtable Primer - General



Sustainable Supply Chain Advisory Committee's  
Truck Fueling Infrastructure  
Roundtable - Primer

May 2020



# List of Contents

1. San Pedro Bay Port (SPBP) Drayage Fleet Foundations
  - Key statistics on fleet population, clean truck transition targets, and the ports' anticipated Clean Truck Incentive Program
2. Estimated Infrastructure Needs
  - Energy required to support the SPBP drayage fleet under scenarios of full conversion to battery-electric vehicles, natural gas vehicles, or hydrogen-electric vehicles
3. N/ZE Truck Manufacturer and Fleet Perspectives on Infrastructure
  - Summary of truck OEM and drayage truck fleet insights shared during previous SSCAC roundtables

# 1. San Pedro Bay Port Drayage Fleet Foundations

## Population: 17,471 Class 8 Drayage trucks total

- 12,845 active (73% of total population)
  - MY'07-'09: 5,187
  - MY'10-'13: 3,765
  - MY'14+: 3,983
- 95% Diesel - 4% Natural Gas – 1% Other
- ~67% LMCs have small (<20 unit) fleets
- Majority of trucks driven by IOOs

## Port Truck Critical Compliance Targets

- 2020: MY2014 required for new port truck registrations; ZE are rate-exempt
- 2023: MY2010 or newer required to remain in truck registry; NZE or better required for new truck registration
- 2035: 100% ZE drayage truck goal

## San Pedro Bay Port Clean Truck Incentive Program

- Starting in Q3 2020, a \$10/TEU rate will be assessed on trucks that do not meet the NZE or ZE standard
- Revenue (est. \$90MM/year) to support the adoption of clean trucks by port drayage operators
- Terms of use of revenue for a program incentive to buy clean trucks currently under consideration

# 2. Estimated Infrastructure Needs

## 2018 Feasibility Assessment

- Considered fleet size of 11,000 and 18,000 trucks
- Estimated 42% of fleet has space for on-site fueling/charging infrastructure
- 58% of fleet would require public access fueling/charging infrastructure
- Public access infrastructure is critical to current drayage fleet
  - NGV: 9-14 large stations
  - EV: 1,200-2,000 charging stalls for multi-hour charge sessions
  - FCV: 100-175 stations at 1,500 kg/day capacity per station

Estimated AFV Fuel Demands (Source: 2018 SPBP Drayage Truck Technical Feasibility Study)

Fueling Station Type / Location	11,000 Truck Fleet	18,000 Truck Fleet
<b>On-site Stations – Daily Energy Throughput</b>		
Trucks Served	4,620	7,560
Natural Gas	215,600 DGE	352,800 DGE
Electricity	2.75 GWh	4.50 GWh
Hydrogen	114,400 kg	187,300 kg
<b>Public Stations – Daily Energy Throughput</b>		
Trucks Served	6,380	10,440
Natural Gas	297,700 DGE	487,200 DGE
Electricity	3.80 GWh	6.21 GWh
Hydrogen	158,000 kg	258,600 kg
<b>Total Daily Energy Throughput</b>		
Natural Gas	<b>513,000 DGE</b>	<b>840,000 DGE</b>
Electricity	<b>6.55 GWh</b>	<b>10.71 GWh</b>
Hydrogen*	<b>272,400 kg</b>	<b>445,900 kg</b>

**Context for 11,000 Truck Fuel and Infrastructure Needs Estimates:**

513,000 DGE natural gas = 3% SCG average daily delivery; 16 large (10-lane) fueling stations  
 6.55 GWh = 2% LADWP+SCE average daily sales; 2.7x Tesla global Supercharger network  
 272,400 kg H2 = 1% of US average daily production; 22x CA fueling station network

\*Hydrogen values not included in Feasibility Study, but are estimated here using LCFS Program EER values



### 3. N/ZE Truck Manufacturer and Fleet Perspectives on Infrastructure (2017-2019)

*Between 2017 and 2019, the SSCAC convened truck manufacturers and fleets to discuss the development and deployment of N/ZE drayage trucks for the San Pedro Bay Ports. Their perspectives on the role of infrastructure in this work is generally summarized below and supported on the following two slides.*

**NGV production volumes are strong and infrastructure is moderately developed; both can be scaled to meet demand in the near term.**

*Meanwhile,*

**BEV production volumes are low and will remain limited until infrastructure solutions become more clearly defined for the customer. FCEV demonstrations have not yet begun for the port drayage segment.**

# 3. NZE Truck Manufacturer and Fleet Perspectives on Infrastructure Availability

Manufacturers of NGVs are prepared to scale production to 8,000/yr over a 6-month period, and expect infrastructure will scale accordingly

- No limitation on natural gas production volumes is anticipated

Manufacturers of BEVs and FCEVs may have the capacity to scale production, but do not see clear customer demand because customers do not see clear fueling solutions. Progress in this area is hindered by:

- Lack of supply – the HD BEV and FCEV network is nascent, and both fueling industries’ abilities to supply enough fuel and fueling equipment to support large-scale deployments is unclear.
- Lack of standardization - no standard has been defined, and, some interfaces are being sold without Nationally Recognized Testing Laboratory (e.g. UL) listing, creating a higher perceived risk of disruption during construction/commissioning.
- Lack of clear process and timeline – infrastructure development requires multiple parties whose actions are limited by a lack of standardized and clearly accepted market practices.

Appropriate applications of BEV and FCEV are undefined

- How will these two fuel-technology architectures be used in the larger trucking market?
- What balance of public/private, fast/slow fueling infrastructure will best meet needs in these applications?

# 3. ZE Truck Manufacturer and Fleet Perspectives on Infrastructure Cost

## Cost of fueling is unpredictable, mitigating customer appetite for BEV technologies

- Electricity rate structures are inconsistent across large territories
- Electricity rates vary by time of day, and season
- Fast-fueling can have unpredictably high costs

## Funding is available but often poorly aligned and from diverse sources

- Funding for infrastructure and funding for vehicles are often not available from the same sources
- Customers often have to cobble together funds from disparate sources to cover project costs

## Funding terms are restrictive

- The relationship between funding, charging standards, and NRTL listing restricts what infrastructure a fleet can purchase, in turn restricting what vehicles it can purchase
- These terms can limit the project scope and scale