Port of LONG BEACH THE GREEN PORT
THE PORT OF LOS ANGELES

SAN PEDRO BAY PORTS

CLEAN AIR ACTION PLAN

Stakeholder Advisory Meeting

November 21, 2024

Agenda

1. Welcome
2. Status Update on the 2023 Emissions Inventory
3. Status Update on Technology Advancement and Grants
4. Status Update on 2024 Feasibility Assessments

2023 San Pedro Bay Ports Air Emissions Inventory Results

Justin Elloran
Port of Los Angeles

Background

- Annual activity-based
  - 2005 – 2023
- Source categories
  - Ships, harbor craft, cargo handling equipment, trucks, trains
- Pollutants/Greenhouse gases
  - PM_{10}, $PM_{2.5}$, DPM, NOx, SOx, CO, HC, CO_2e (CO_2, CH_4, N_2O)
- Annually coordinated with & reviewed by EPA, CARB, & South Coast AQMD

2023 Unique Factors

- Ports returned to pre-pandemic operations and cargo volumes
- Factors positively affecting 2023 emissions include:
  - Port Tariff amendment in 2018 requiring all new trucks that register in the Ports' Drayage Truck Registry to be 2014 model year or newer. Ports saw increased mileage driven by 2014 and newer model year trucks.
  - Use of renewable diesel fuel by all harbor craft, some container terminals, and switcher locomotives
  - Voluntary purchase and use of zero emission cargo handling equipment

SPBP 2023 Air Emissions vs. 2005

Diesel Particulate Matter

DOWN

91%

2023 Goal 77% ✓

Nitrogen Oxides

DOWN

72%

2023 Goal 59% ✓

Sulfur Oxides

DOWN

98%

2023 Goal 93% ✓

Greenhouse Gases

DOWN

20%

17%

TEUs

*Compared to 2005 Levels

**GHG emissions (CO_2e) are reported in metric tons per year; all other pollutants are shown in tons per year.

SPBP 2023 Air Emissions vs. 2022

Diesel Particulate Matter	Nitrogen Oxides	Sulfur Oxides	Greenhouse Gases
DOWN 20%	DOWN 25%	DOWN 23%	DOWN 18%

TEUs
13%

*Compared to 2022 Levels
**GHG emissions (CO_2e) are reported in metric tons per year; all other pollutants are shown in tons per year.

SPBP 2023 Air Emissions vs. 2017

Diesel Particulate Matter
DOWN
20%

Nitrogen Oxides
DOWN
34%

Sulfur Oxides
DOWN
23%

Greenhouse Gases
DOWN
8%

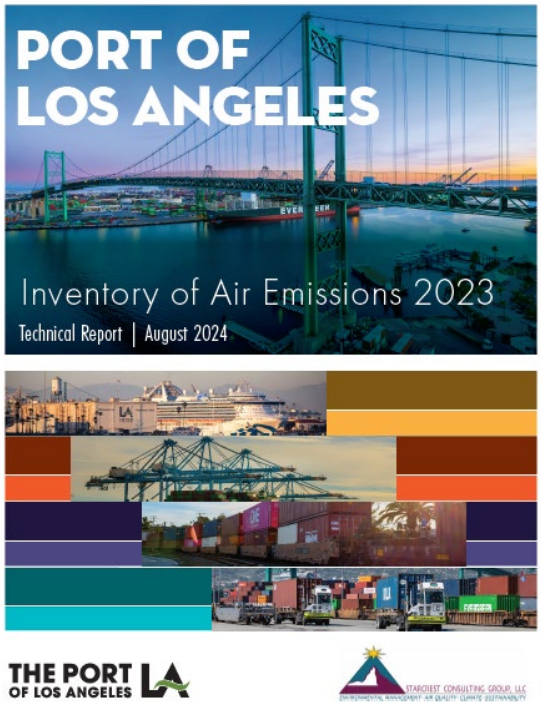
TEUs
1%

*Compared to 2017 Levels
**GHG emissions (CO_2e) are reported in metric tons per year; all other pollutants are shown in tons per year.

Moving Forward

- Technology Advancement
- Clean Truck Fund Rate
- ZE Truck Deployment
- Ship Incentive Programs
- Green Shipping Corridors
- State and Federal Regulations

2023 Air Emissions Inventories



https://www.portoflosangeles.org/environment/air-quality/air-emissions-inventory

https://www.polb.com/environment/air/#emissions-inventory


Thank you!

Status Update on Technology Advancement and Grants

Questions or comments?
Submit: caap@cleanairactionplan.org

Rose Szoke, Port of Long Beach
Brittney Ford, Port of Los Angeles

Overview

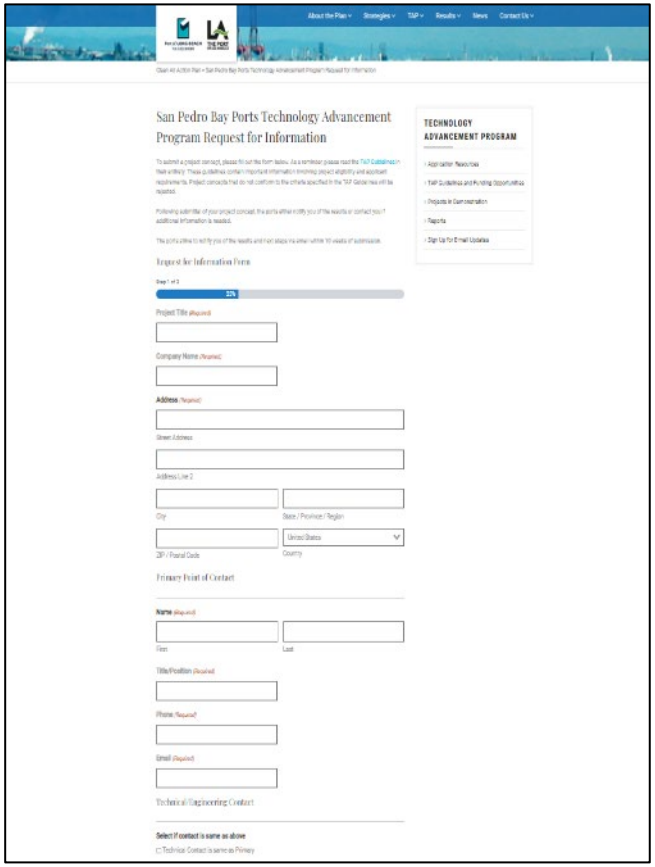
- Technology Advancement Program (TAP) Update
- 2024 TAP Project Concepts
- Technology Demonstrations and Deployments
- Ports' Grant-Funded Demonstration and Deployment Stats
- EPA Clean Ports Program Award
- Looking Forward

TAP Request for Information

- Project concepts may be submitted via the TAP RFI at:

  www.cleanairactionplan.org/TAP

- **Six** project concepts submitted to the TAP in 2024
- The TAP Advisory Committee evaluates proposals and provides funding recommendations

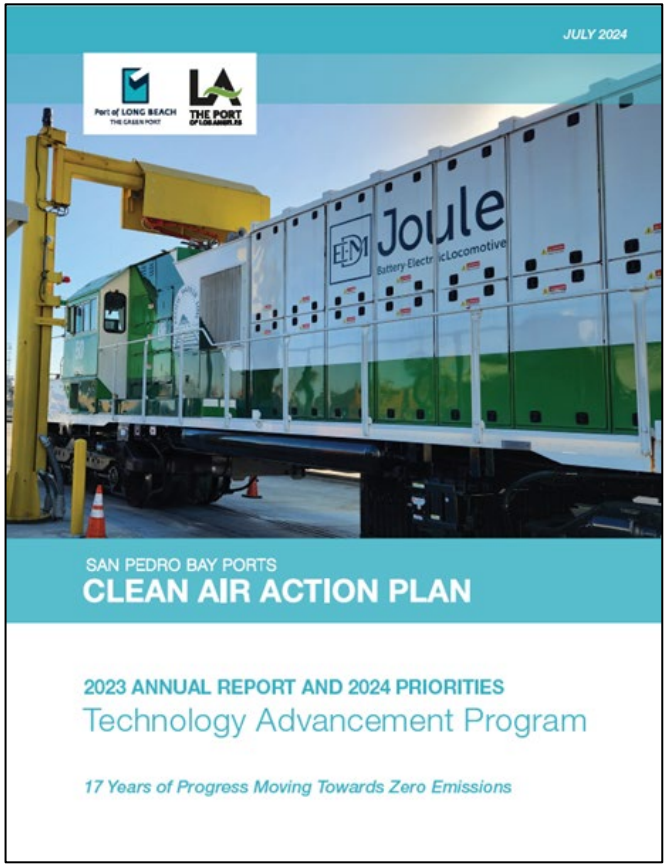


TAP Project Concepts Received

- Hands-Free Charging Infrastructure
- Zero-Emission (ZE) Straddle Carrier Retrofit
- ZE Hybrid Excursion Boat
- Innovative Class 8 Truck Chargers (Solid-State Transformers)
- Innovative Class 8 Truck Chargers (Megawatt Charging System)
- ZE Tugboat

TAP Annual Report

- **2023 TAP Annual Report available on the CAAP Website**
- 2024 TAP Annual Report in progress
- Plan to release the 2024 Report by Q2 2025



SSA HFC Top Handlers Demonstration

- **Project:** Two newly built HFC top handlers by Taylor Machine Works
- **Demo Location:** SSA Pier C
- **Status:** Delivery of units expected in late 2025
- **Ports' TAP Funds**: $2.19M
- **Private Match**: ~$4.3M

Photo Credit: Taylor Machine Works

PASHA LNG OGV Vessels Demonstration

- **Project:** Two newly built dual-fueled diesel/LNG ships; one retrofitted ship
- **Demo Location:** SSA Pier A
- **Status:** All vessels have been delivered and are now in service between Hawaii and Long Beach
- **Ports' TAP Funds**: $1M
- **Private Match**: ~$470M

Photo Credit: PASHA Hawaii

START Project

- **Project:** Deploy 33 eUTRs with charging infrastructure and 5 electric drayage trucks
- **Demo Locations:** SSA Pier C, Shippers Transport Express
- **Status:** In Progress
- **State Funds:** ~$23.4M
- **Private Match**: ~$6M

2022 Port Infrastructure and Development Program

- **Project:** Deploy 60 ZE yard tractors and charging infrastructure
- **Demo Location:** LBCT Pier E
- **Status:** Design and permitting phase in progress
- **Federal Funds:** ~$30M
- **Private Match**: ~$7.5M

2023 Port Freight and Infrastructure Program

- **Projects:** Replace 63 diesel cargo-handling units with zero-emission alternatives, including hydrogen-powered units, and install the necessary charging and fueling infrastructure at LBCT and SSA. It also allocates $107 million for incentive programs and expands shore power at Tesoro's Berth T-121, LBT, and T2 to support more vessel connections.
- **Demo Locations:** SSA Pier C, SSA Pier F, LBCT and Tesoro
- **Status:** In Progress
- **State Funds:** ~$224.9M
- **Private Match**: ~$100.3M

Toyota Tsusho Demonstration

- **Project:** Converting a conventional diesel top handler to run on hydrogen fuel cell (HFC)
- **Demo Location:** Fenix Marine
- **Status:** Demonstration to conclude late 2024
- **Ports' TAP Funds**: $860,000
- **Private Match**: ~$4M

Photo Credit: Toyota Tsusho

PHL ZE Locomotive Charger Demonstration

- **Project:** Testing a ZE locomotive charger
- **Demo Location:** Pacific Harbor Line Railyard
- **Status:** Demonstration to conclude December 2024
- **Ports' TAP Funds**: $845,390
- **Private Match**: ~$3.5M

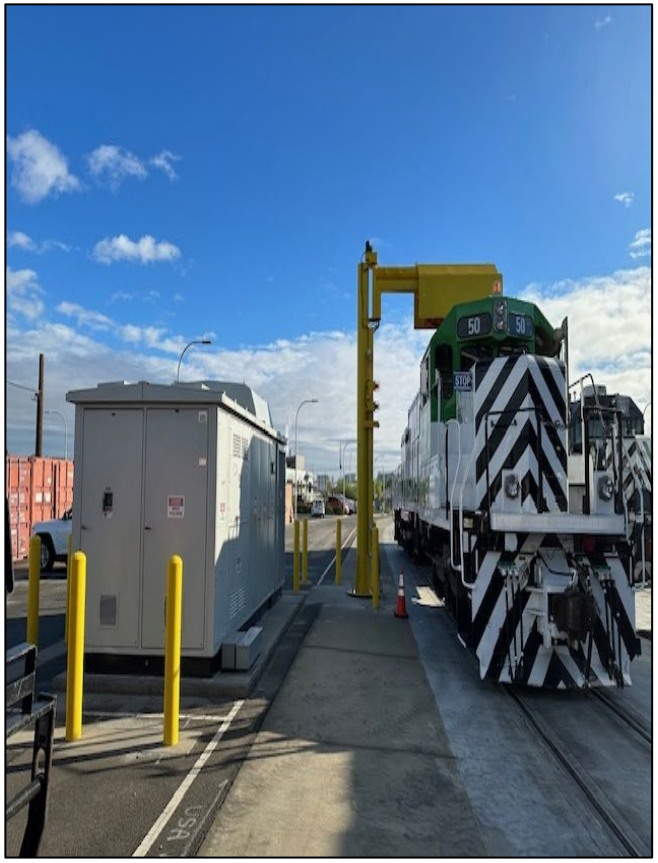


Photo Credit: PHL

AERAS At-Berth Capture and Control Demonstration

- **Project:** CARB Test plan for RoRo Ship Emission Reduction Apparatus
- **Demo Location:** Various
- **Status:** Initial project tasks began in Fall 2024
- **POLA TAP Funds**: $750,000
- **Private Match:** $5M

Photo Credit: AERAS Technologies

Zero Emission Freight Vehicle Advanced Infrastructure Demonstration (AID)

- **Project:** Battery electric yard tractors supported by an advanced integrated wireless infrastructure system
- **Demo Location:** Ports America (WBCT)
- **Status:** Completed second critical report
- **Grant Funds:** $7,842,270
- **Private Match:** $3,945,320

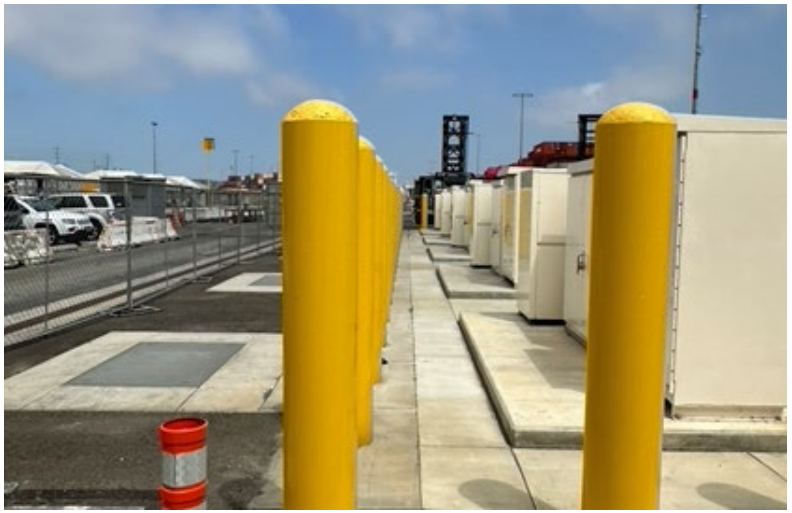


Photo Credit: WAVE

Ports Grant-Funded Demonstration and Deployment Stats

- Since 2017, the San Pedro Bay Ports have secured significant funding to support the transition to ZE vehicles and equipment with the Port of Long Beach securing **$331M** and the Port of Los Angeles securing **$492M**.
- The Ports are under contract negotiations with DOE/ARCHES to procure an additional **$300M** to support the hydrogen hub effort.
- The Ports have supported the deployment of **127** grant-funded ZE vehicles and equipment to date.
- The Ports have secured funding to support deploying an additional **919** grant-funded ZE vehicles and equipment over the next **3 to 5 years**.

EPA Clean Ports Program Award - NEW

- $412M awarded to the Port of Los Angeles for ZE projects from the 2024 EPA Clean Ports Program
- The Sustainable Equipment Adoption: Community, Harbor, and Neighborhood Growth & Empowerment (SEA-CHANGE) project deploys:
  - ~ 337 ZE Yard tractors
  - ~ 56 ZE Top Handlers
  - ~ 25 ZE Forklifts
  - ~ 244 Chargers
  - ~ 250 ZE trucks
  - ~ 1 Shore power

Harbor Community Benefits Foundation

- Harbor Community Benefits Foundation (HCBF) is a non-profit organization operating within the neighboring communities around POLA
- EPA Clean Ports award will provide $50 million to HCBF

HCBF Role:

- Conduct extensive community engagement for the whole project
- Manage a community-driven subgrant program
- Issue subgrants within EPA's guidelines

ARCHES Hydrogen Hub Funding & Deployment

- The Alliance for Renewable Clean Hydrogen Energy Systems (ARCHES) submitted a State of California hydrogen hub application, which included the Ports of Long Beach, Los Angeles, and Oakland.
- The application received a $1.2B award. The San Pedro Bay Ports were awarded $300M ($150M per port) to replace diesel cargo equipment with hydrogen fuel cell equivalents.
- Over 50 hydrogen fuel cell units per port planned.
- Specific terminal deployment locations to be determined.
- Ports are contracting with ARCHES and Department of Energy to begin Phase 1.

Looking Forward

- Since 2022, the Ports have secured approximately $823M in state and federal funding, which will be used over the next three to five years to support CAAP objectives. The Ports will be focused on grant implementation.
- The Ports will continue collaborating with terminal operators to develop zero-emission infrastructure master plans, ensuring readiness for ZE operations.
- Both Ports will actively explore new opportunities for collaboration on technology deployment and demonstration projects.
- The Ports will pursue state and federal grant opportunities.

Contacts/Information

- **Brittney Ford, Port of Los Angeles: bford@portla.org**
- **Rose Szoke, Port of Long Beach: rose.szoke@polb.com**

- www.cleanairactionplan.org
- www.polb.com/zeroemissions
- www.portoflosangeles.org/environment/air-quality/zero-emissions-technologies


Thank you!

Update on 2024 Feasibility Assessment for Class 8 Drayage Trucks

November 21, 2024

Class 8 Truck Feasibility Assessment

Assess the current feasibility of zero-emission technologies for drayage operation

Examine the readiness of supporting infrastructure and evaluate economic considerations

Analyze the operational feasibility and requirements for implementing zero-emission technology in port operation

Engage with various stakeholders, including port personnel, technology developers, regulatory agencies, and industry associations

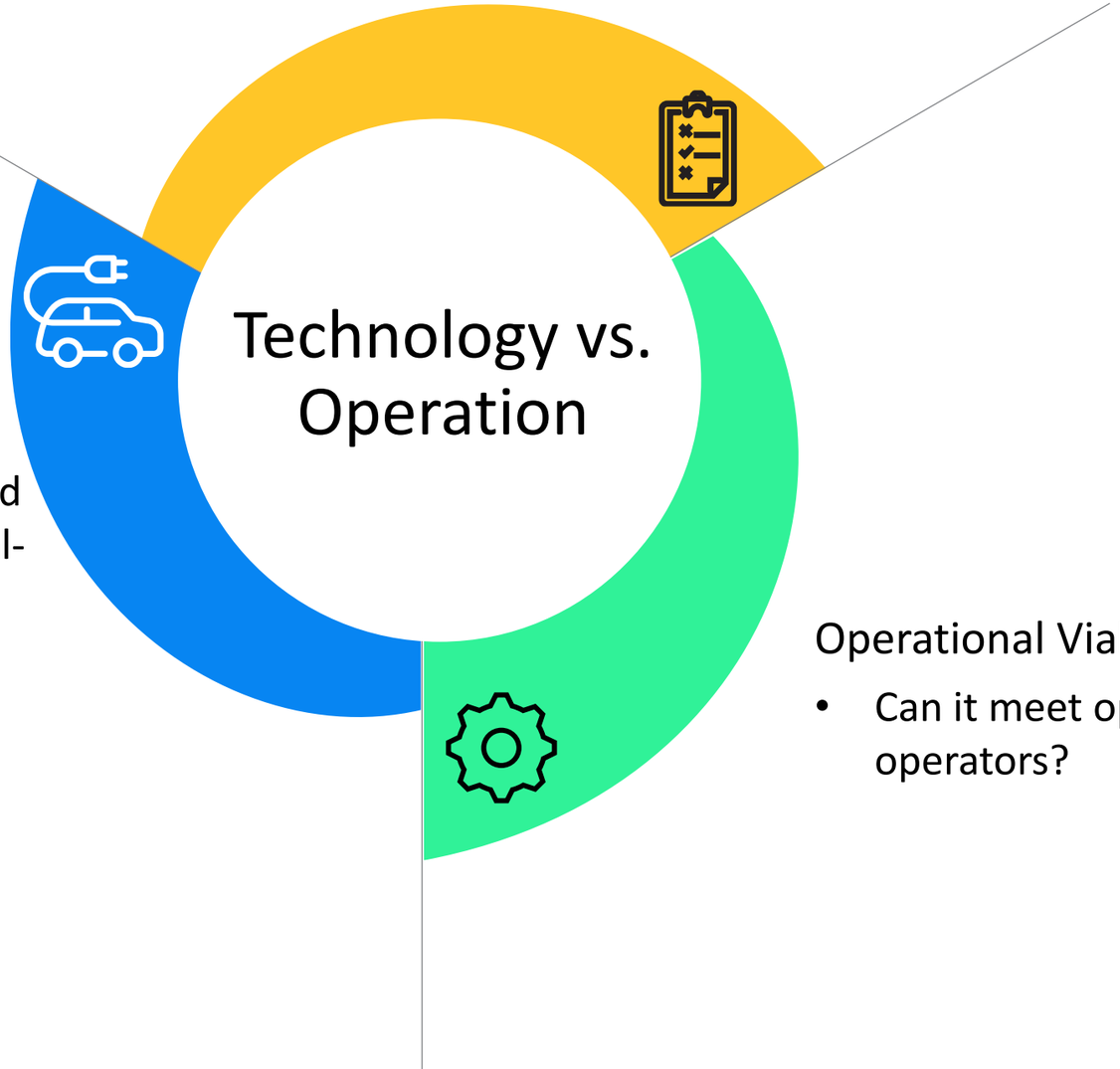
Port's Clean Air Action Plan – Feasibility Assessments

PHASE 1

June – October 2024

Commercial Viability

- *Manufacturing Capability*
- *Production Timelines*
- *Support Services*



Technical Viability

- Is the technology proven and ready for deployment in real-world conditions?
- Does it meet the necessary performance standards?

Operational Viability

- Can it meet operational needs of drayage operators?

PHASE 2

November – December 2024

Economic Viability

- Conduct a total cost of ownership analysis for zero-emission technologies, accounting for both direct and indirect costs.
- Assess emissions reductions and establish cost-effectiveness metrics for each technology option.

Infrastructure Gap

- Identify infrastructure gaps and estimate necessary charging and refueling stations
- Assess construction timelines, investment needs, and fuel availability to achieve CAAP goals.

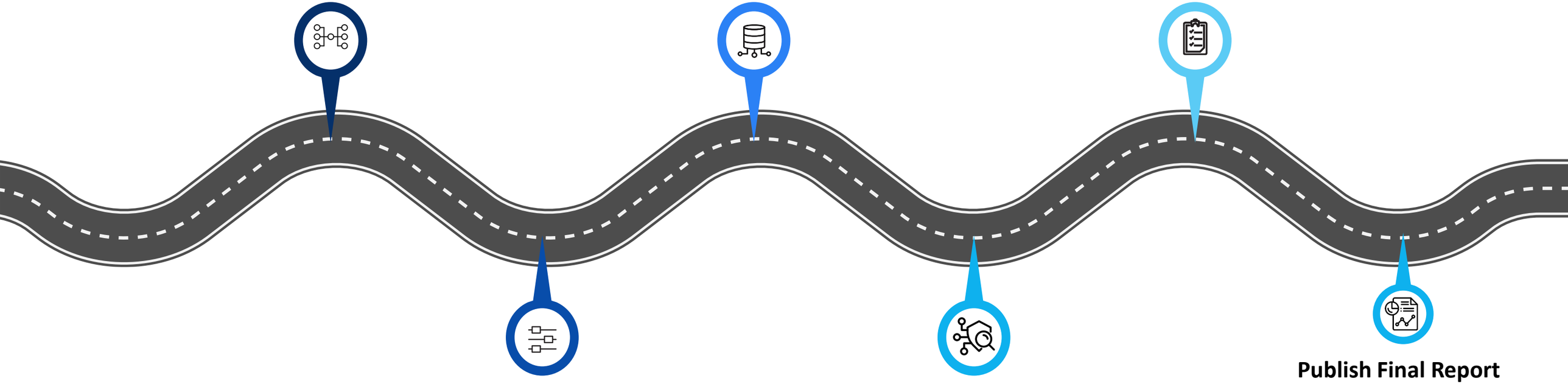
PHASE 3

January - June 2025

Combine All Viability Assessment

Assess Overall Feasibility

Engage Stakeholders for Feedback



Connect Insights

Peer Review for Accuracy

Publish Final Report Publicly

Data Collection

Desk Research: Market research utilizing various data sources on availability of Class 8 zero emission trucks

OEM and Operator Surveys: Collect data on technology specs and operational constraints.

OEM and Operator Interviews: Conduct interviews with key OEM and Operators to understand commercial availability and operational challenges and needs.

Status of Surveys & Interviews

Surveys were Initially sent out on August 19th to OEMs & September 23rd to fleets registered at Port Drayage Truck Registry

47 survey responses

5 OEMs

42 truck operators and fleet.

13 interviews

7 OEMs

6 truck operators and fleets

Today's Make and Models of ZE Class 8 Trucks

Battery Electric Class 8 Trucks – 7 makes and models

Manufacturer	*Model*
BYD	8TT *
Freightliner	eCascadia*
Kenworth	T680E
Lion Electric	Lion8T
Nikola	TRE BEV
Peterbilt	579EV
Volvo	VNR Electric*

**indicate that this model offers more than one configuration*

Sources:
ICF'S EV Library (2024.4.26 ver)
Global Commercial Vehicle Drive to Zero's ZETI tool
DOE's AFDC Alternative Fuel and Advanced Vehicle Search (as of 2024.09.17)
OEMs and Dealership Insights

Hydrogen Fuel Cell Class 8 Trucks – 5 makes and 6 models

Manufacturer	*Model*
Kenworth	T680 6x4
Nikola	TRE FCEV
Peterbilt	579HFC
Hyundai	XCIENT*
Hyzon	HyHD8
Hyzon	HyMax*

** indicate that this model offers more than one configuration*

Sources:
Global Commercial Vehicle Drive to Zero's ZETI tool
DOE's AFDC Alternative Fuel and Advanced Vehicle Search (as of 2024.09.17)
HVIP
OEMs and Dealership Insights

Build America, Buy America (BABA) Compliance:

- 2 battery electric models (eCascadia, TRE)
- 3 hydrogen fuel cell models (TRE, HyHD8, HyMax)**

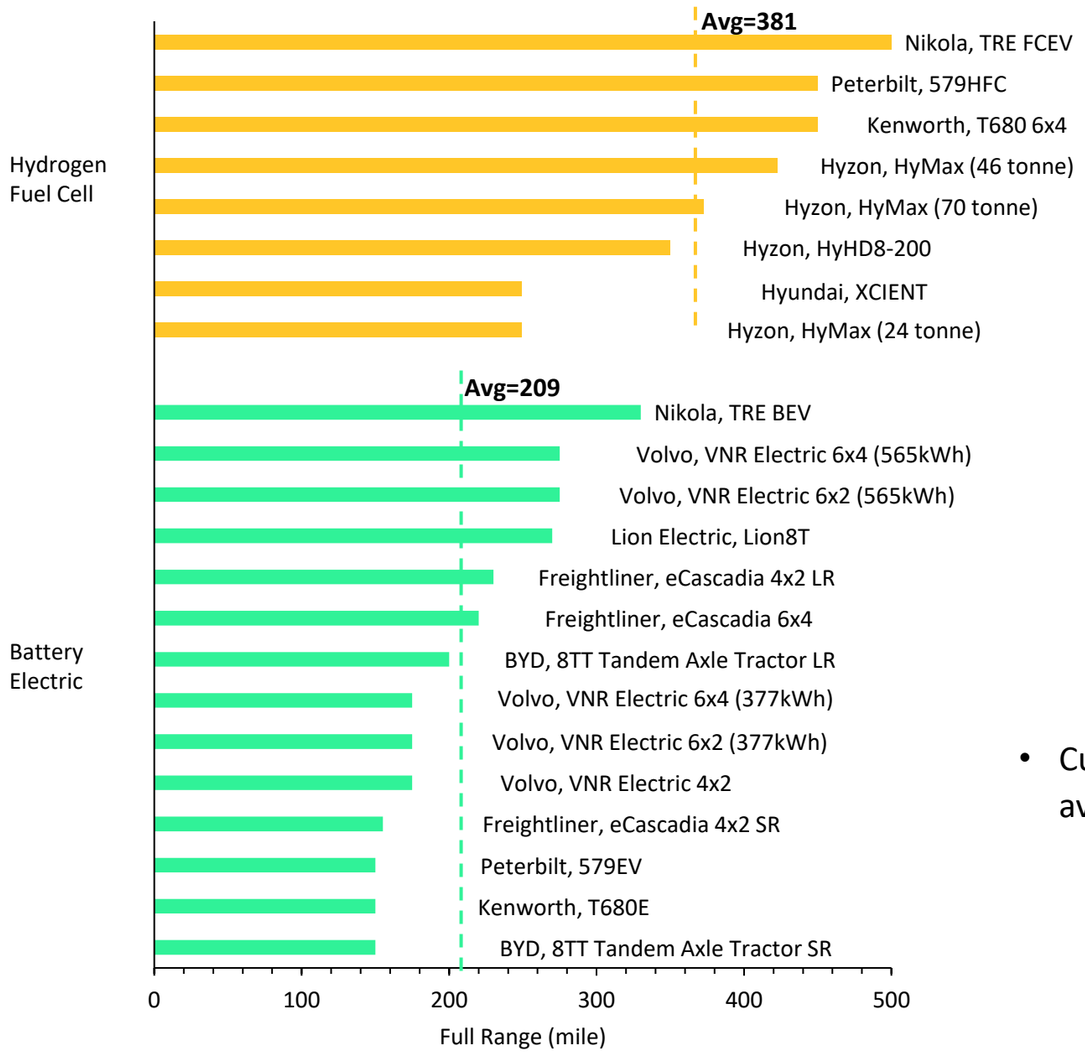
**Though the computation of BABA compliance is not clear to all OEMs.*

OEM

Key Specs of Current Offerings – Range and Curb Weight

The vehicle's weight affects payload capacity while the electric range determines how far the truck can travel on a single charge, impacting operational downtime and route planning

Full Range



Curb Weight

Vehicle Type	*Make*	*Model*	*Curb weight (lb.)*
Battery Electric	BYD	8TT	26,235
	Freightliner	eCascadia 4x2 SR	16,994
		eCascadia 4x2 LR	19,054
		eCascadia 6x4	21,390
	Kenworth	T680E	22,500
	Lion Electric	Lion8T	26,000
	Nikola	TRE BEV	28,800
	Volvo	VNR Electric	20,000 to 25,000
Fuel Cell Electric	Nikola	TRE FCEV	26,000
	Kenworth	T680FCEV	22,500
	Hyzon	HyHDB8	22,000

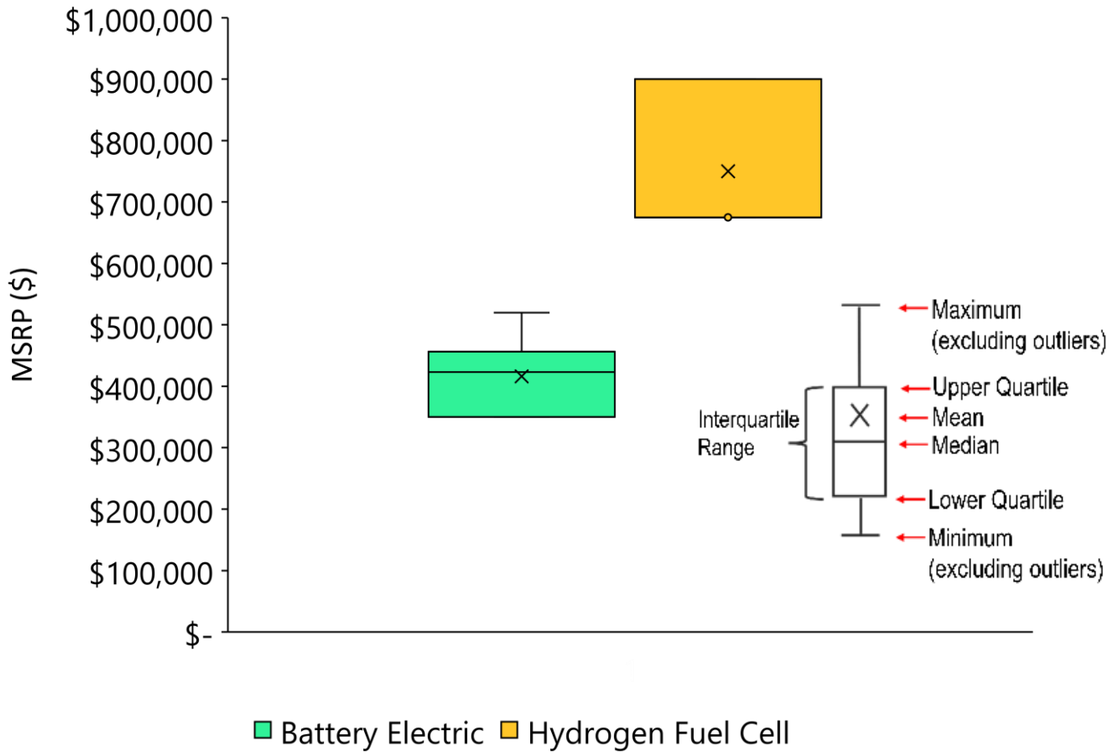
- Curb weight for battery and fuel cell electric Class 8 drayage trucks is about 23,000 lbs. on average, which is **8,000 lbs. heavier** than a non-ZE Class 8 drayage trucks in general.

OEM

Key Specs – MSRP and Charging

MSRP is directly correlated with the upfront costs, and charging speed impact how quickly the trucks can return to operation

MSRP

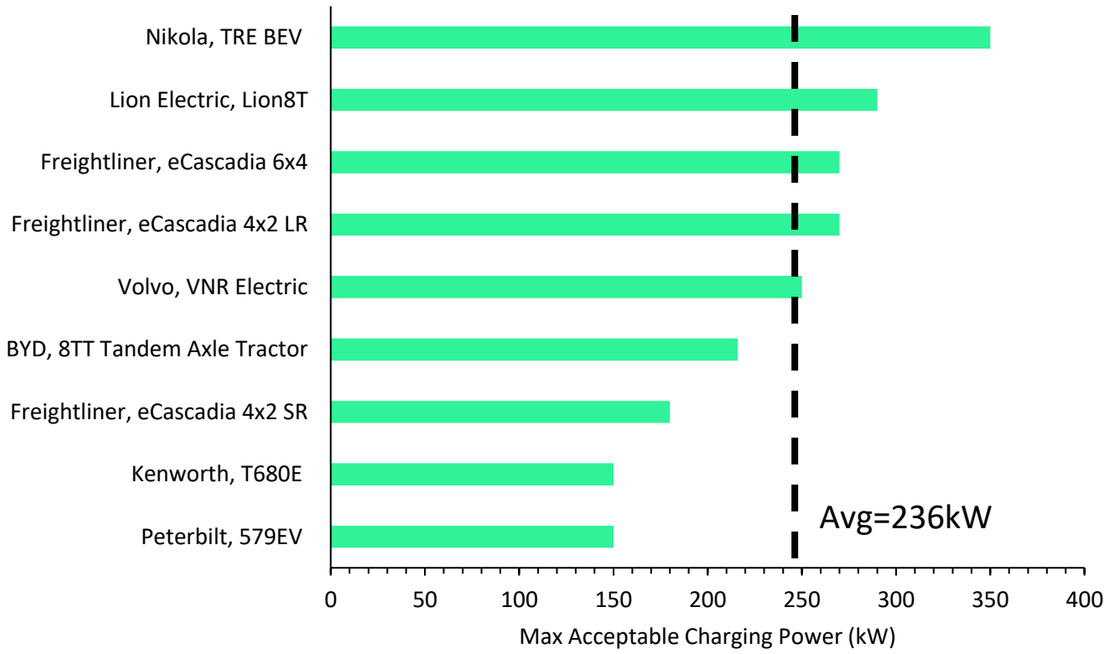


**MSRP may vary depending on configurations.*

Based on the data collected, MSRP for battery electric drayage trucks ranges from $350k to $520k per vehicle, with an average of **$416k** per vehicle. For hydrogen fuel cell drayage truck, it ranges from $675k to $900k per vehicle, with an average of $**750k** per vehicle.

Maximum Acceptable Charging Power

Across 7 different models (9 configurations)



All battery electric Class 8 drayage trucks are **CCS compatible only.**

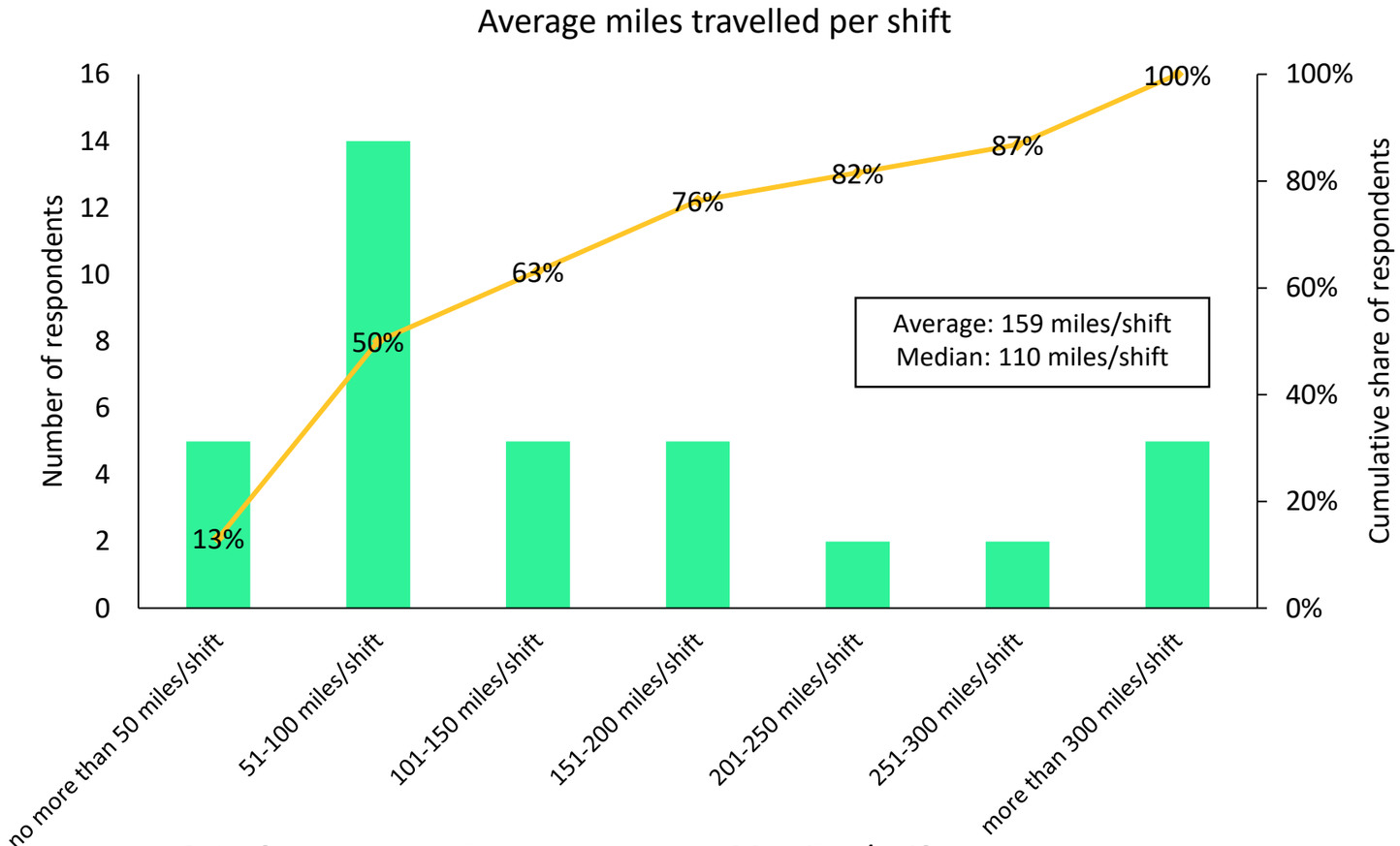
Key Findings from OEM Interviews

- **Scaling Manufacturing**: Demand-driven, with infrastructure as a crucial factor.
- **MW Charging**: Included in long-term roadmaps for some; actively pursued by others.
- **Challenges for Class 8 Trucks**: Funding limitations, lack of support for small fleets, high insurance, range concerns, fluctuating electricity prices, and infrastructure issues.
- **Customer Support:** OEMs offer consulting on charging solutions, subsidize fuel, and assist with site planning and funding applications.
- **Customer Feedback:** Positive experiences due to quiet operation and comfort; BEVs valued for acceleration, FCEVs for quick refueling.
- **Additional Recommendations:** Expedite voucher processing, increase port charging and parking facilities, and open incentive programs to large fleets.

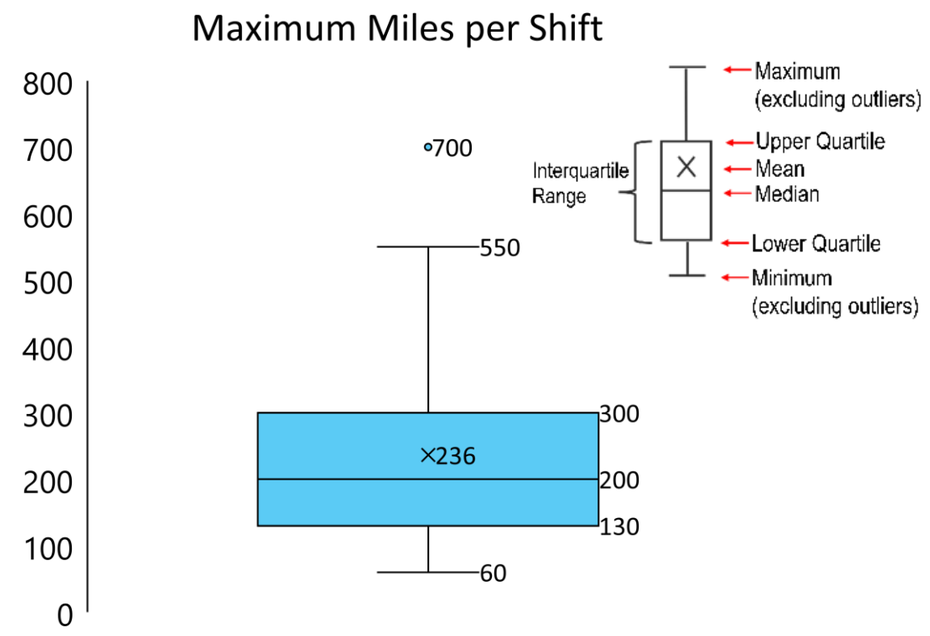
Fleets

Operator Range per Shift

Understanding operational range per shift is important to ensure zero-emission drayage trucks can complete daily routes without disruptions



- 50% of trucks travel no more than 100 miles/shift on average.
- 25% of trucks travel more than 200 miles/shift on average.
- 55% of respondents' trucks are on a 1-shift schedule.



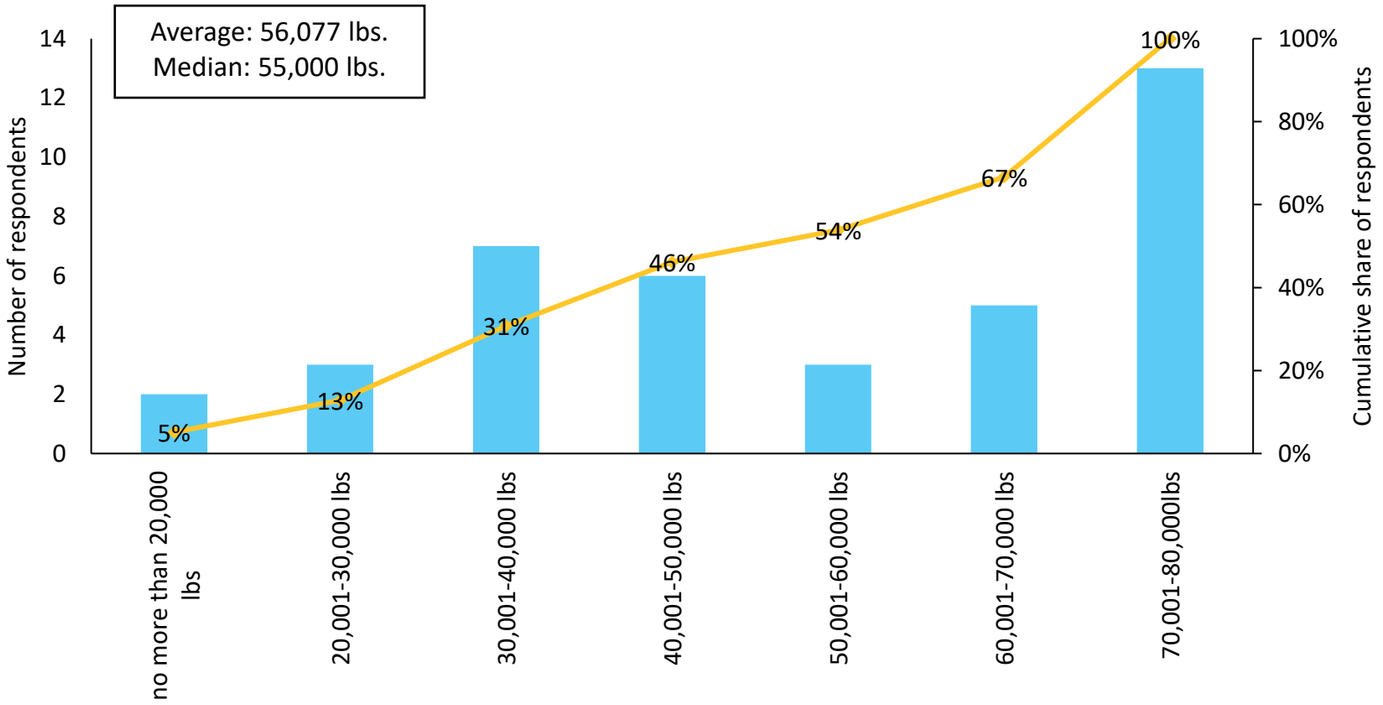
- Maximum miles per shift range from 60 to 550 miles.
- Average of 236 miles.

Fleets

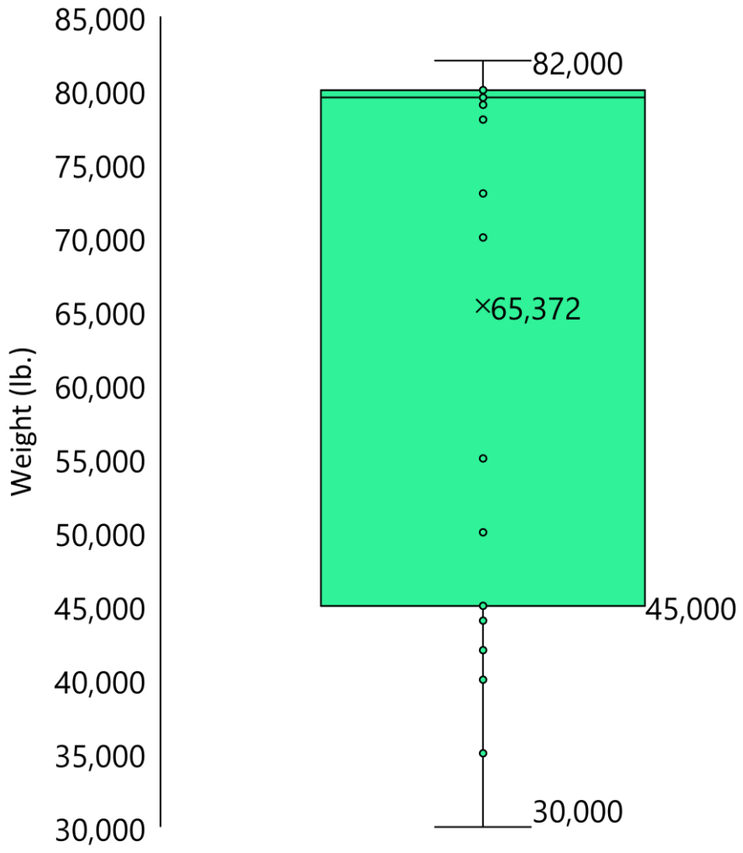
Operator Loaded Operating Weight

Understanding loaded weight is important to ensure zero-emission drayage trucks can handle payloads efficiently within weight limits

Typical loaded operating weight (incl. cargo)



Maximum loaded operating weight (incl. cargo)



- 54% have a typical loaded weight below 60,000 lbs.
- 33% report typical loaded weight between 70,001 lbs. and 80,000 lbs.
- **Maximum** loaded weight ranges from 45,000 to 80,000 lbs., with **an average of 65,372 lbs.** and a median of 79,500 lbs.

13

Fleets

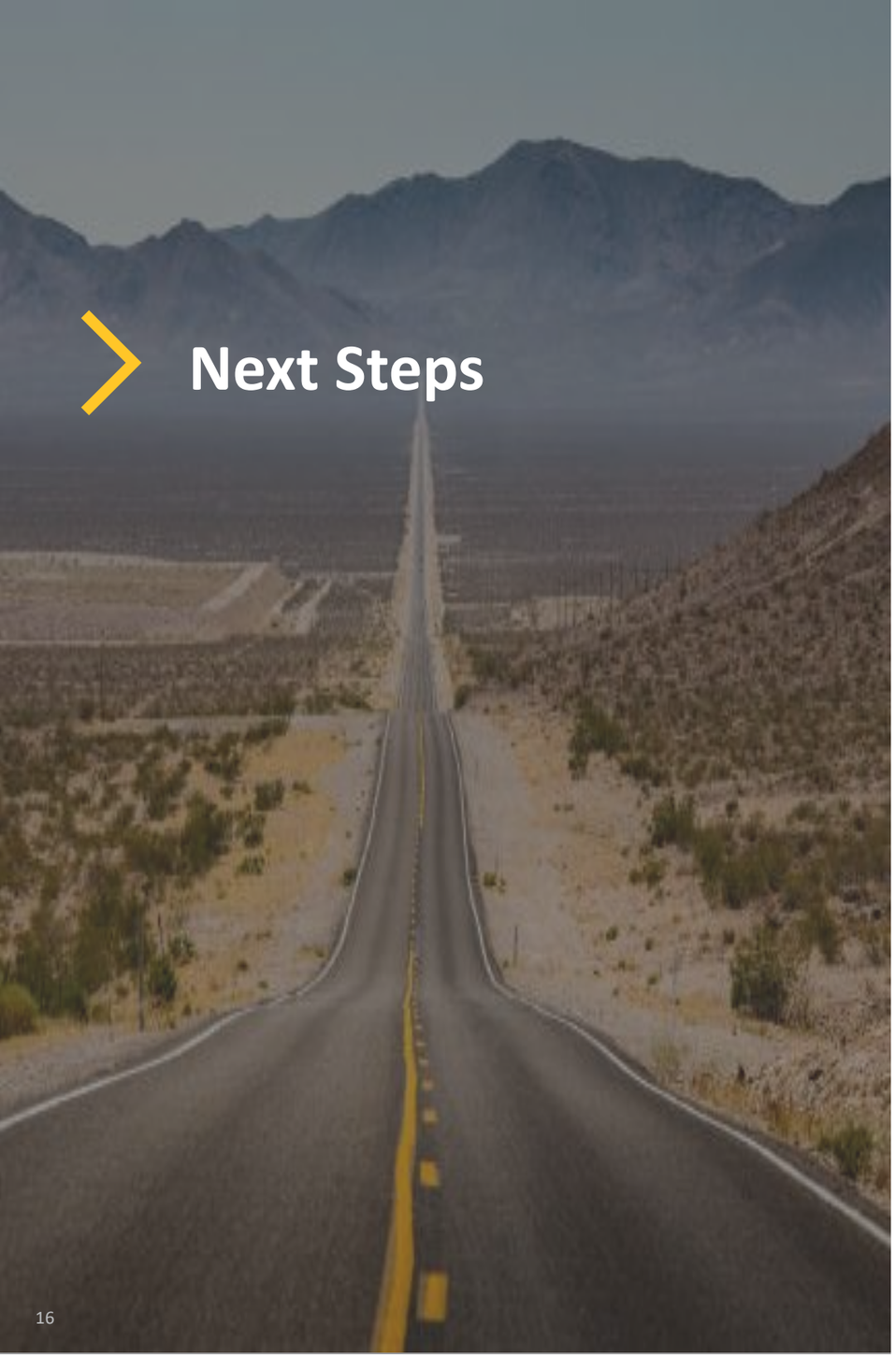
Perceived challenges in operating ZE Class 8 trucks

Top three challenges in operating ZE Class 8 trucks are:

- Range limitation;
- Infrastructure cost;
- Infrastructure availability.

Some also had concerns about safety and overall ZEV market readiness.

Next Steps



Next Steps

- Connect data from OEM & Drayage Operators surveys and interviews
- Assess if current technology meets operational needs.
- Conduct financial feasibility assessment.
- Perform infrastructure gap analysis.
- Draft report for public review.
- Future updates to CAAP stakeholders

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Questions?

Thank you!

icf.com

- twitter.com/ICF
- linkedin.com/company/icf-international
- facebook.com/ThisIsICF
- #thisisicf

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SAN PEDRO BAY PORTS

2024 CARGO HANDLING EQUIPMENT FEASIBLITY ASSESSEMNTS

CAAP Stakeholder Meeting
November 21, 2024

AGENDA

CAAP Stakeholder Meeting

November 21, 2024

1. Introduction
2. Study Objective and Approach
3. Outreach and Survey Efforts / Preliminary Findings
   - Marine Terminal Operator (MTO) Surveys
   - Electric Yard Tractor Assessment
4. Study Timeline
5. Next Steps

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Study Objective

In-Scope Equipment and Evaluation Criteria

- Develop an updated **feasibility assessment of Zero-Emissions (ZE) Cargo Handling Equipment** (CHE) to inform the San Pedro Ports' deployment strategy in meeting their 2030 ZE targets.

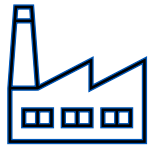
- Assessment of the following battery-electric (BE) and hydrogen fuel cell (HFC) CHE:
  - Rubber-tired gantry (RTG)

    (*Grid-electric in addition to BE and HFC)*
  - Top/Side Handler
  - Heavy Forklift
  - Yard Tractor

Study Objective

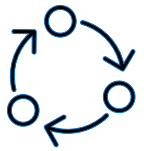
In-Scope Equipment and Evaluation Criteria

> The ZE equipment will be assessed against the following **evaluation criteria**:



Commercial Availability

Technology Readiness



Infrastructure Availability

Operational Feasibility

Economic Consideration

Study Approach

Task Breakdown

Task 1: Research & Information Gathering

Task 2: Analysis and Report Writing

Task 3: Stakeholder Engagement

Task 4: Public Comment Period

Outreach and Survey Efforts

High-level Summary

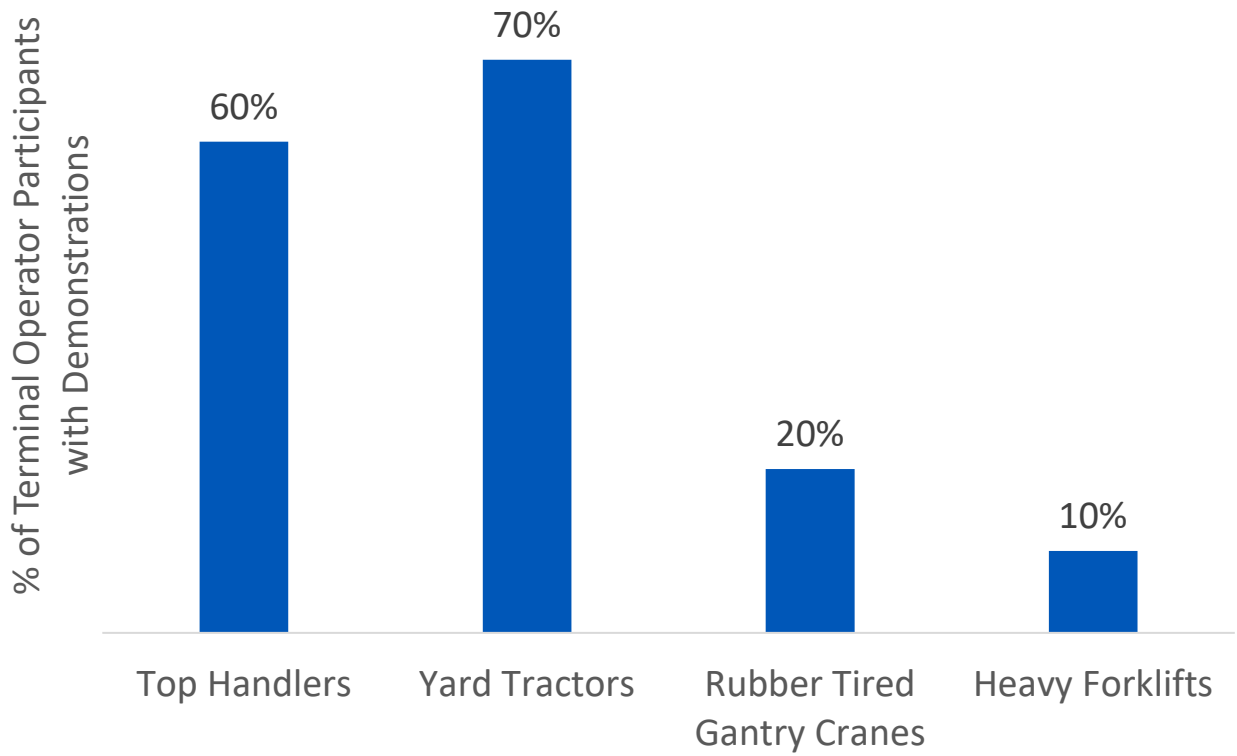
	MTO	RTG OEM	Yard Tractor OEM	Top/Side Handler OEM	Heavy Forklift OEM*	Charging OEM
Survey/Interview Requests	10	4	8	2	3	5
Respondents	9	2	2	1	1	3
Status	Complete	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing

* These overlap with other interview requests because these OEM's manufacture multiple types of ZE equipment.

Marine Terminal Operator Surveys

High-level Summary

- BE CHE has been the most widely demonstrated ZE technology.
- HFC top handlers and RTGs are being demonstrated at two terminals in 2024.
- Top handlers and yard tractors have been the most frequently demonstrated ZE equipment.



Marine Terminal Operator Surveys

Infrastructure and Utility Challenges

- High Infrastructure Costs
- Terminal Operation Disruptions during Construction
- Electric and Hydrogen Infrastructure Lead Times
- Hydrogen Supply Issues
- Grid Reliability and Power Outages

Marine Terminal Operator Surveys

Equipment Performance and Reliability

- Reliability Issues with Early-Generation Equipment
- Single-Shift Readiness
- Mixed Performance in Two-Shift Operations
- Challenges with Charging Systems
- Charging Labor Requirements

Marine Terminal Operator Surveys

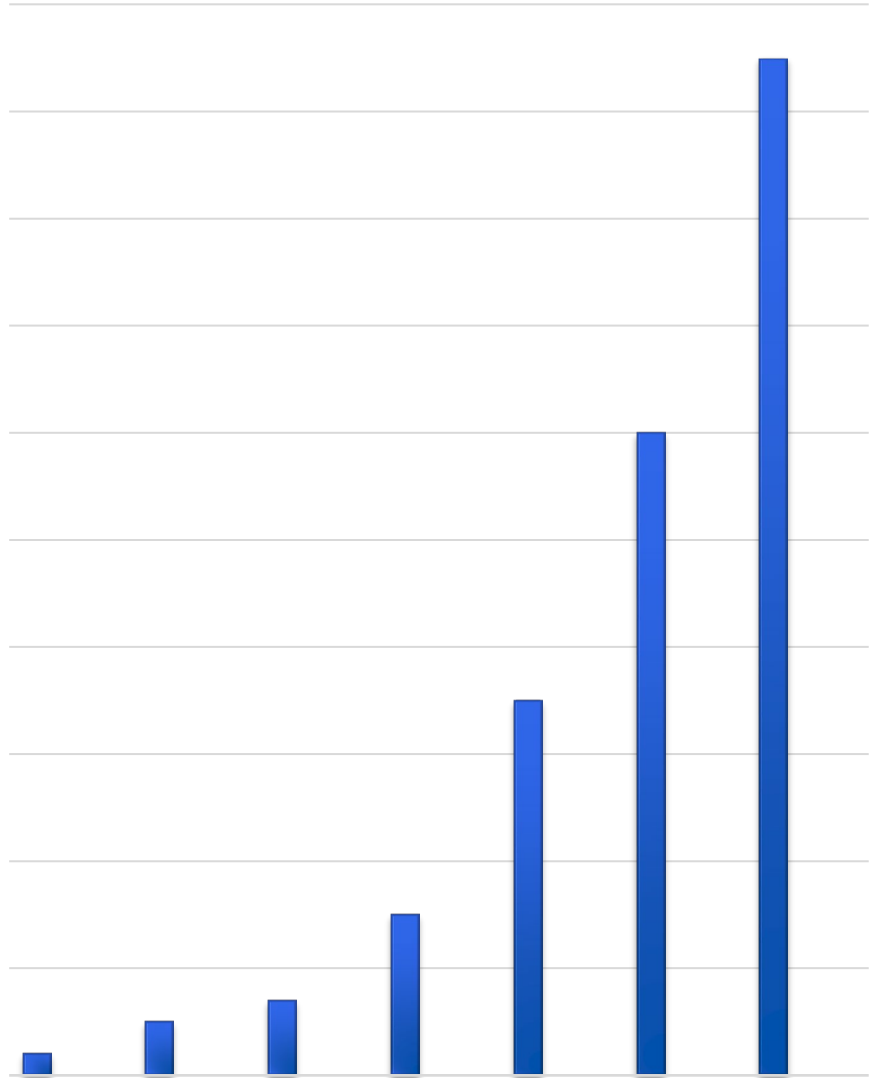
Economic Considerations and Funding Needs

- High Equipment and Infrastructure Capital Costs
- Electricity Demand Charges
- Cost of Hydrogen
- Grant Dependency
- Uncertainty of Potential Operational Savings

Marine Terminal Operator Surveys

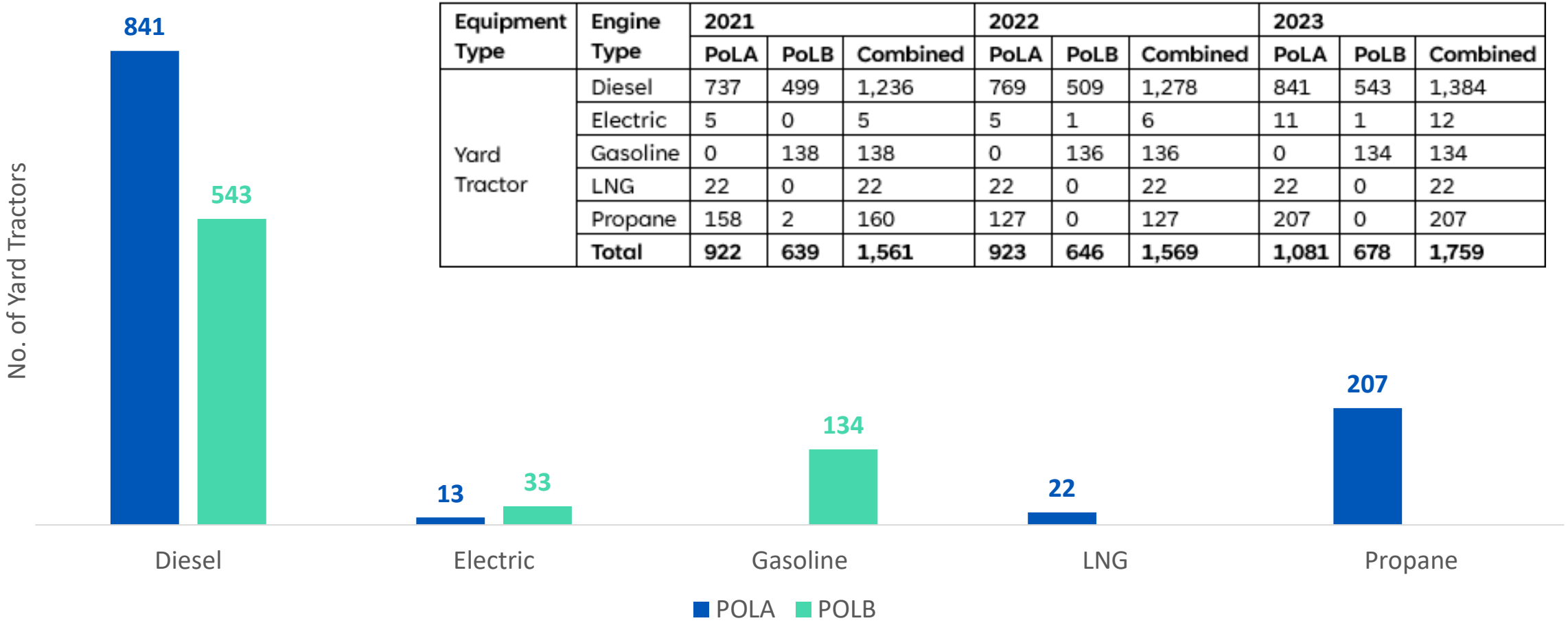
Adaptability and Long-term Strategy

- Importance of Pilot Projects and Phased Implementation
- Phased Transition to Manage Risks and Costs
- Safety Concerns and Operational Adjustments
- Space Requirements of ZE Charging Infrastructure



Yard Tractors Preliminary Review

2023 Deployments and Demonstrations



Equipment Type	Engine Type	2021			2022			2023		
		PoLA	PoLB	Combined	PoLA	PoLB	Combined	PoLA	PoLB	Combined
Yard Tractor	Diesel	737	499	1,236	769	509	1,278	841	543	1,384
	Electric	5	0	5	5	1	6	11	1	12
	Gasoline	0	138	138	0	136	136	0	134	134
	LNG	22	0	22	22	0	22	22	0	22
	Propane	158	2	160	127	0	127	207	0	207
	Total	**922**	**639**	**1,561**	**923**	**646**	**1,569**	**1,081**	**678**	**1,759**

At POLA, number of BYD battery-electric UTRs increased from 5 to 13 between 2022 and 2023.
As of Oct 2024, there are 33 battery-electric UTR being demonstrated at POLB. There have been other demonstration projects at other terminals planned in 2025.

Electric Yard Tractor Preliminary Review

Current Market Offerings

- **Seven OEMs** are selling battery-electric yard tractors certified and listed by CARB as eligible for incentive funds under the CORE (Clean Off-Road Equipment) project:
  - As of 2021: Orange EV, Kalmar Ottawa, BYD
  - New after 2021: TICO, Terberg, Autocar, MAFI
- **Certified Models** (Make and Model)

Autocar	E-ACTT
Orange-EV	e-Triever/Husk-e
Kalmar	TX22
TICO	Pro-Spotter EV
MAFI	T230E
Terberg	YT203EV
BYD	8Y

TICO

OrangeEV

BYD

MAFI

Source: California CORE Eligible Equipment Catalog

Electric Yard Tractor Preliminary Review

Typical Specs

- **Battery Capacity**: 210 kWh to 250 kWh*, with larger capacities supporting longer operational shifts.
- **Charging Rate:** 150 kW* for most models, except Orange EV (105 kW) and BYD (130 kW), enabling relatively quick turnaround times for high-capacity batteries.
- **Charging Time and Operational Range:** 1-2 hours for 8 to 10 hours of usage*, depending on the model and application.
    - Electric yard tractors are typically equipped to handle single shifts (up to 8 hours) on a full charge.
    - Meeting double shifts (16+ hours) will likely require opportunity charging (short charging sessions during breaks).
- **Charging Standards:** Moving to CCS1 charging protocol.
- **Payload capacities:** Most models support up to 81,000 lbs, and some reaching as high as 90,000 lbs (MAFI)*.
- **Operational testing:** There is a need for need for further operational testing and validation to better understand equipment capabilities and reliability, especially in extended operations.

Kalmar

Autocar

Terberg

* TICO announced a next generation Pro Spotter EV in May 2024 with 312 kWh of battery capacity, max charge rate of 175 kW , and payload capacity up to 160,000 lbs.

Hydrogen Fuel Cell Yard Tractor Preliminary Review

Market Research Update

- **Capacity trucks:** Launched BE and HFC hybrid jockey trucks in early 2023.
- **Toyota:** Tested the UNO HFC yard tractor at POLA in 2019. Currently focused on improving fuel cell powertrains for greater efficiency and operating time. The business model includes providing HFC systems and software to equipment OEMs, such as Kalmar.
- **Terberg & Taylor:** Introduced the YT203-H2 electric yard tractor in 2020, with testing in Europe. The model is operational in the EU market, with plans to enter the North American market by 2025 through collaboration with Taylor.
- **Hyster:** Announced the H2 Terminal Tractor in 2023 at the Terminal Operations Conference Europe. Developed in partnership with Capacity Trucks, with initial testing planned in Germany.
- **Gaussin:** ATM-H2 38T HFC yard tractor launched in 2021, with initial testing in France in 2022.
- **Kalmar:** Partnering with Toyota, Tsusho America and Ricardo to develop and test HFC yard tractor series.

Gaussin

Toyota

Kalmar

Terberg

Capacity

Anticipated Study Timeline

Milestones

- Research/Data Reviews: **July - September 2024**
- OEM/Operator Interviews: **September - November 2024**
- Develop Assessment: **December 2024 - February 2025**
- Peer Review Period: **March 2025**
- Drafts for Public Comment: **April 2025**
- Peer Review Period: **May 2025**
- Final Assessment: **June 2025**

Next Steps

Complete Information Gathering Effort

> Finalize market research on ZE RTGs, top/side handlers, and heavy forklifts.

> Complete OEM surveys and interviews.

> Consolidate insights from market research, surveys, and interviews into feasibility assessment.

> Prepare a draft assessment report for review by Ports.