SAN PEDRO BAY PORTS

CLEAN AIR ACTION PLAN

Clean Truck Program Update
2nd Quarter 2019

Clean Trucks Program

Goal of 100% Zero Emissions Trucks by 2035

- New Registration Requirements and Clean Trucks Rate
- Other Strategies: Truck Reservation System, Pilot Smog Check Program, Early Action for Near-Zero-Emissions Trucks

Joint Ports CTP Statistics

- 18,253 trucks are in the PDTR
- 1,447 MY 2014+ trucks registered in the PDTR since October 1, 2018
- 55% trucks in the PDTR are 2010 EPA compliant trucks
- 45% trucks in the PDTR are 2007 EPA Compliant
- 48% of the moves are being done by 2010 EPA compliant trucks
- 623 LNG trucks are signed up in the PDTR
- 3.7% of the moves are being done by LNG trucks
- There are 32 Low NOx trucks that use the .02 Cummins natural gas engines in the PDTR
- There are approximately 10 Zero Emission Trucks in the PDTR

Near-Term CTP Milestones

- 2018 – Pre-2014 Trucks can no longer register in PDTR - **Complete**
- 2020 - Clean Truck Rate goes into effect on non-NZE/ZE Trucks
  - Contingent on:
    - Completion of Truck Feasibility Assessment, including evaluation of availability of trucks
    - Completion of Clean Truck Rate Study
    - CARB promulgates near-zero-emissions manufacturing standard
    - Rate collection mechanism established

Truck Feasibility Assessment

Key Findings

- Snapshot in time, 2018-2021
- Assessed for technical viability, commercial availability, operational feasibility, infrastructure availability, economic workability
- No technologies fully feasible today
- Near-zero natural gas trucks and battery-electric trucks could be feasible soon

Economic Study for the CTP Rate

Goals:

- Analyze range of rates
- Evaluate anticipated cargo diversion, effect on trucking industry, potential revenue
- Expected summer/fall 2019

Engine Manufacturing Standard

- CARB White Paper (April 2019) indicates phased implementation timeline for near-zero standard
  - Feasible standard of 0.05-0.08 g/bhp NOx for MY 2024-2026
  - Standards TBD for 2027+
- Continued need to harmonize with federal standards
- Staff analyzing the impact on Ports CTP

Rate Collection Mechanism

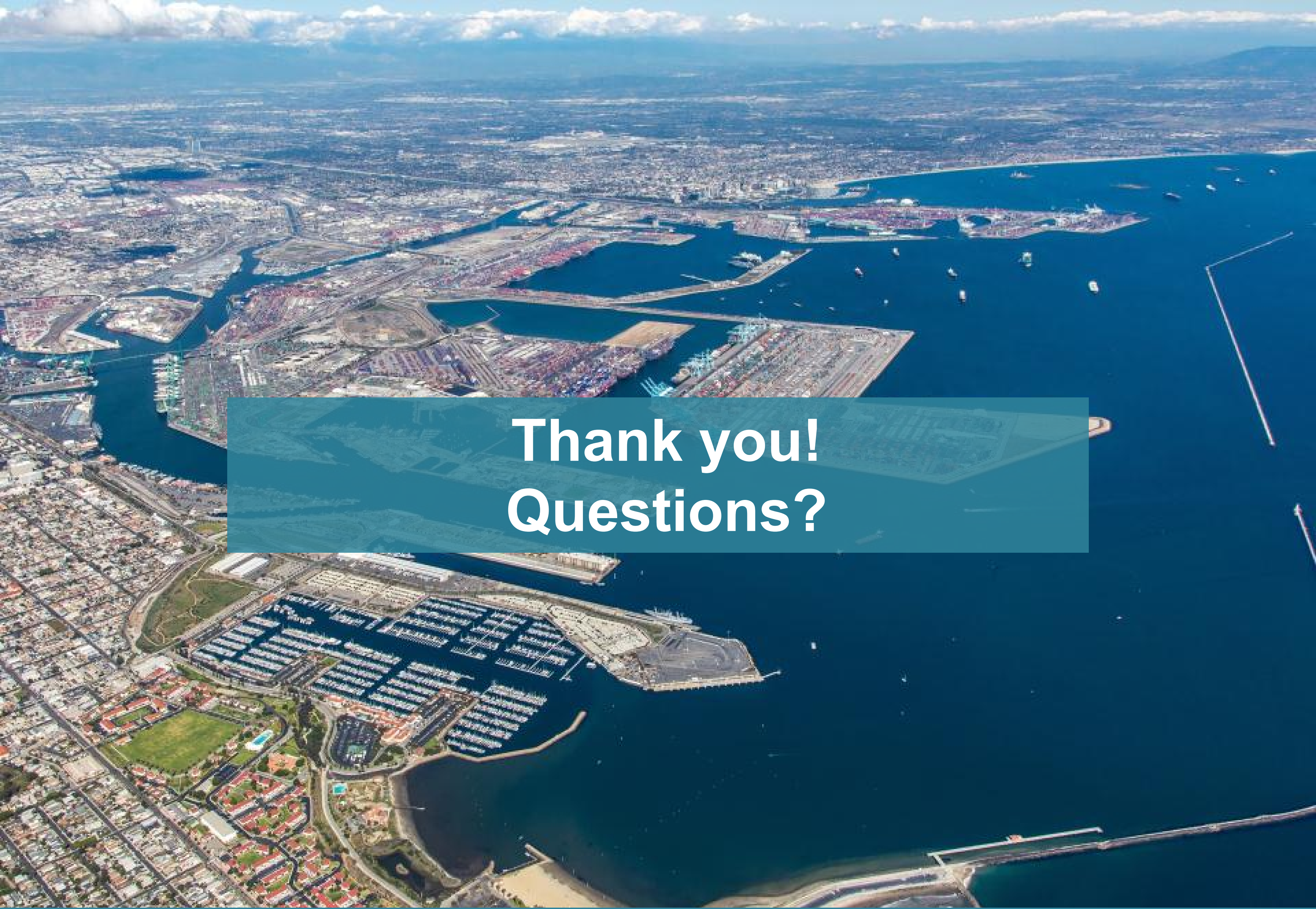
- Request for Statement of Qualifications issued February
- Proposals received late-March
- Proposals under evaluation by a joint Port team
- Contract with selected vendor to respective Boards anticipated in summer

CTP Rate Setting Process

- Launching public engagement process
  - Focused breakout meetings
  - 2 Public Workshops in summer
  - CAAP Quarterly Stakeholder Meetings
  - Information booth at Clean Trucks Center
  - Email: trucks@cleanairactionplan.org
- Anticipate proposal by end of the year

Other Strategies

- Truck Reservation System
- Pilot Smog Check Program – Coordination with CARB
- Early Action for Near-Zero-Emissions Trucks
  - Joint incentive program with AQMD, with grant from CEC
  - Up to 140 ultra-low NOx emission trucks
  - $14 million total, $2 million from each Port
  - Anticipate trucks on the road by end of the year



Thank you!
Questions?

SAN PEDRO BAY PORTS

CLEAN AIR ACTION PLAN

DRAFT 2018 FEASIBILITY ASSESSMENT of CARGO HANDLING EQUIPMENT

June 2019

Presented at the Clean Air Action Plan Public Advisory Meeting

Patrick Couch

June 25, 2019

gna GLADSTEIN, NEANDROSS & ASSOCIATES

TETRA TECH

Feasibility Assessment: Structure

- Feasibility Assessment follows the November 2017 “Framework” document
- Emerging **ZE** and **NZE** fuel-technology platforms are evaluated according to the following five basic parameters:
  1. Technical Viability
  2. Commercial Availability
  3. Operational Feasibility
  4. Availability of Infrastructure and Fuel
  5. Economic Workability

Feasibility Assessment: Additional Parameters

- **Breadth of Application** – Capability for widespread deployment
- **Timeframe** - 2018 to 2021
- **Fuel-Technology Platforms**
  1) Advanced diesel combustion
  2) Natural gas combustion
  3) Other combustion (e.g., propane)
  4) Hybrid-electric platforms (may include combustion)
  5) Pure battery-electric (or grid-electric) systems
  6) Hydrogen fuel cell
- **Sources**

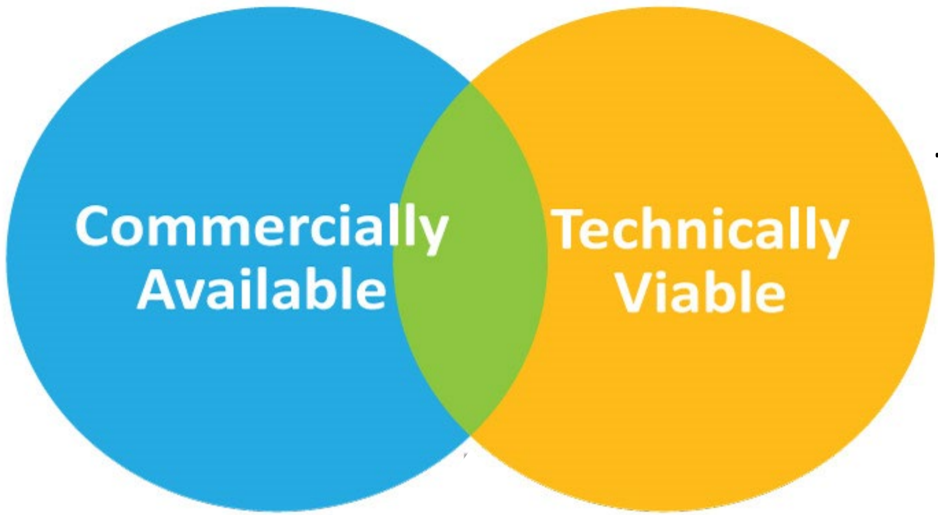
✓Technical reports, papers and literature resources

✓Key agencies (ARB, CEC, AQMD, Ports)

✓Operator interviews

Screening Methodology

Currently available for commercial sale?



Technically capable of performing cargo handling service?

Overview of the CHE Fleet

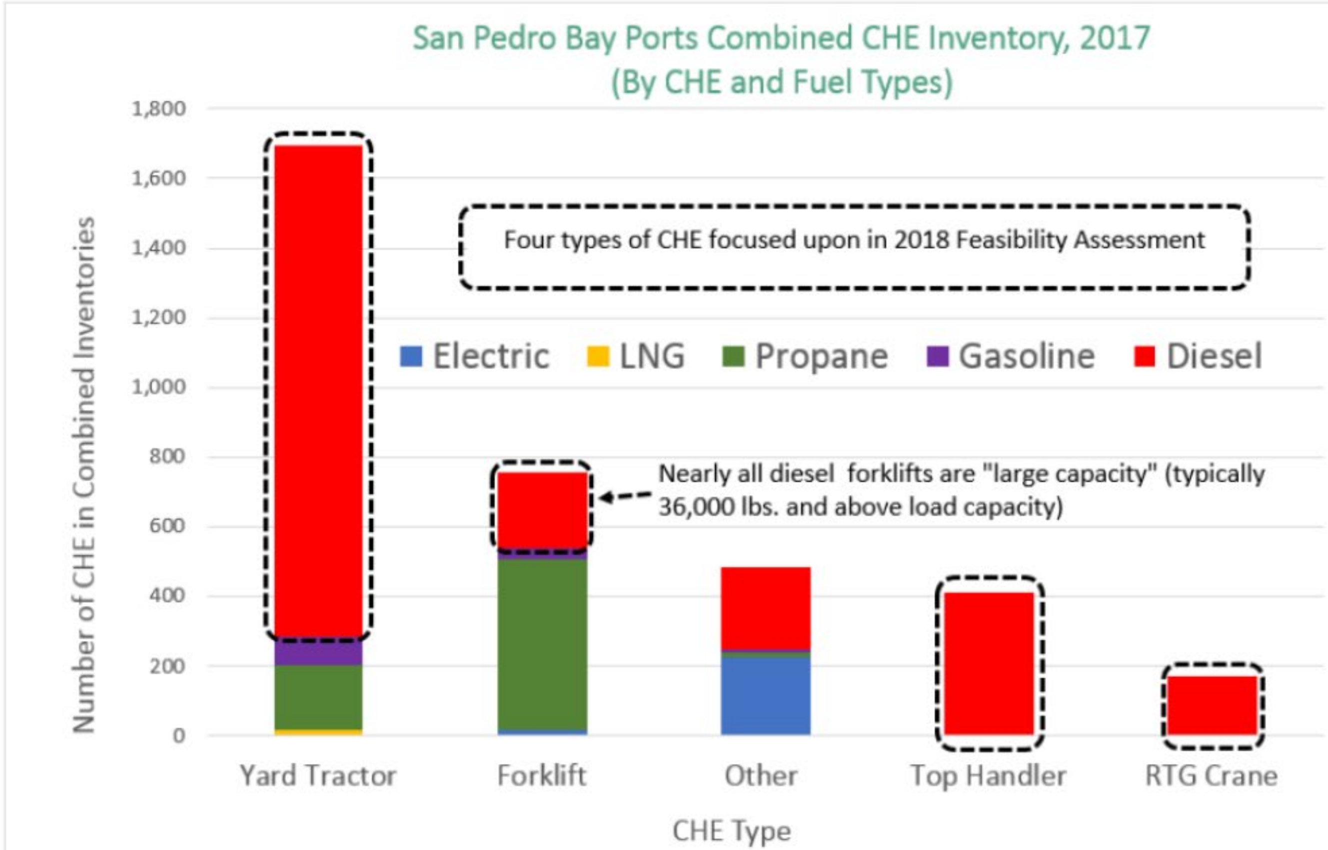
~3,500
Individual CHE

1,693
Yard Hostlers
83%
Diesel ICE

412
Top Handlers
100%
Diesel ICE

169
RTG Cranes
92%
Diesel ICE

221
Large-Capacity Forklifts
100%
Diesel ICE



***Other category includes:** ship-to-shore cranes, automatic stacking carriers, cone vehicles, sweepers, pallet jacks, manlifts, rail-mounted gantry cranes., and various other types (collectively less than 10 percent of the CHE fleet)

Sources: 2017 Air Emissions Inventories prepared by Starcrest Consulting Group, July 2018

Defining CHE Operational Requirements

Developed specifications based on representative baseline diesel models:

- Operating hours based on Ports' Emissions Inventories
- Assessed ability to meet two-shift and three-shift operations
- Allowed for charging between shifts

Table 18. Representative specifications for Yard Tractors

Representative Yard Tractor Specification	
Example Baseline Equipment	Kalmar Ottawa T2, Capacity TJ7000
Fuel Type	Diesel
Axle Config	4x2
Wheel base	116 inches
Engine Power	200-240 HP
GCWR	81,000 lbs.
Top speed	25-33 mph
Fuel Capacity	50 gallons
Estimated Endurance	20 hours

Table 19. Representative specifications for RTG Cranes

Representative RTG Crane Specification	
Example Baseline Equipment	Konecranes, Kalmar, ZPMC RTG cranes
Lift Capacity	65 tons
Spreader Capacity	20, 40, and 45 feet
Wheel Span	77 feet
Hoist Height	1 over 6 high cubes
Hoist Speed	30 meters/minute loaded, 60 meters/minute empty
Trolley Speed	75 meters/minute
Gantry Speed	135 meters/minute (empty spreader)
# of Gantry Wheels	8
Engine Power	600-1,000 HP
Fuel Capacity	700 gallons
Estimated Endurance	70+ hours

Commercial Availability: Methodology and Criteria

- Commercial CHE should be manufactured, certified (emissions, safety, etc.), sold, and supported by a major OEM
  - ✓ 1) Proven means of production
  - ✓ 2) Financial stability
  - ✓ 3) Established network of dealers to sell new or used products and replacement parts
  - ✓ 4) Ability to provide essential end-user support (maintenance, warranty, financing, training)

Data Sources:

- Interviews with Marine Terminal Operators
- Publicly available OEM statements and specifications
- Technology demonstrations

Commercial Availability:

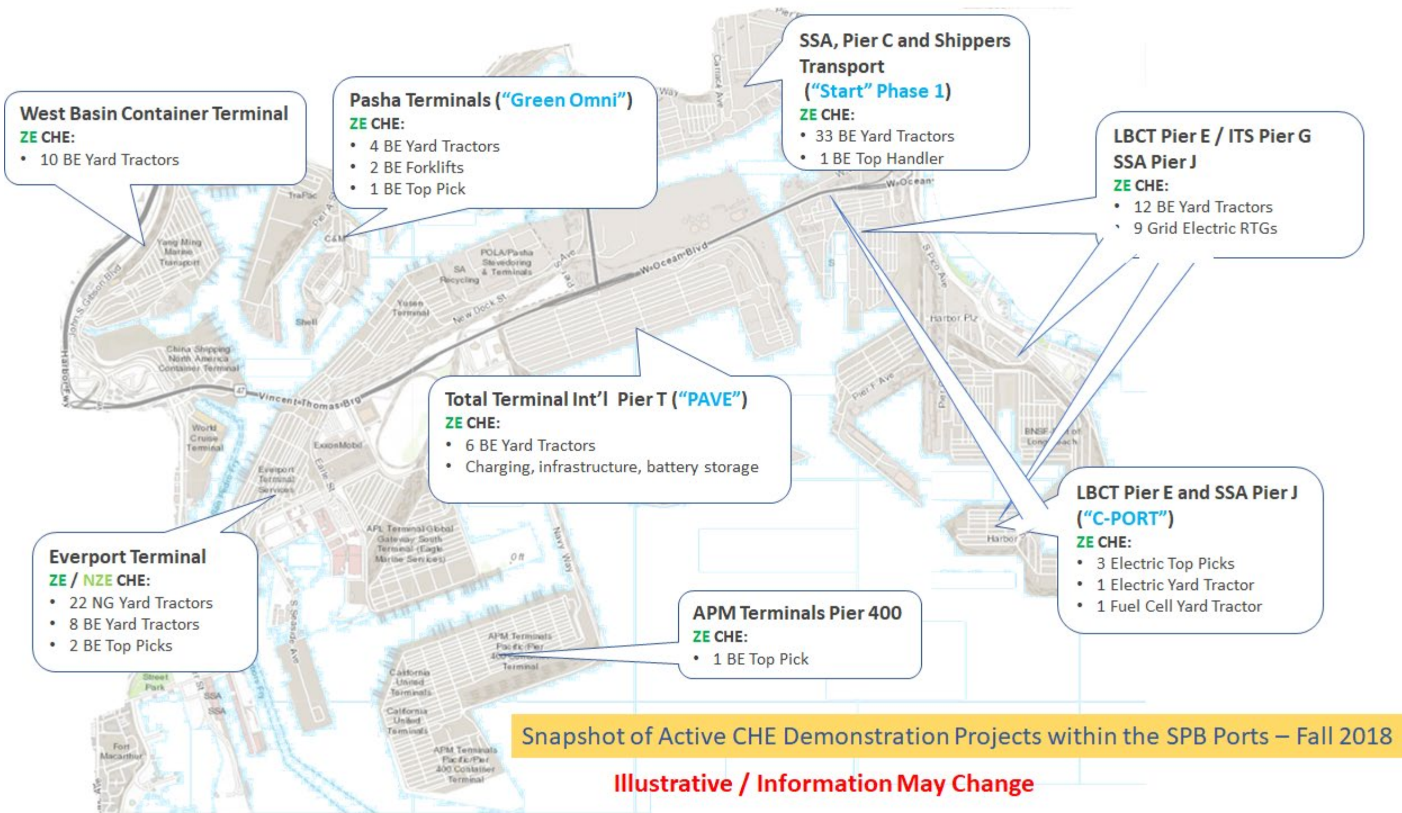
Pre/Early Commercial Demonstrations

Yard Tractors	Top Handlers*	RTG Cranes	Large-Capacity Forklifts
• 111 ZE battery-electric	• 10 ZE battery electric	• 9 ZE grid electric	• 12 ZE battery electric
• 2 ZE fuel cell	• 1 ZE fuel cell		
• 22 NZE natural gas ICE			

*The top handler category includes one battery-electric reach stacker.

Source: Grant announcements from the San Pedro Bay Ports and various government agencies

Note: this information is evolving and is not meant to be definitive.



Illustrative / Information May Change

Commercial Availability:
Pre/Early Commercial Demonstrations

- Mid-2018: ~24 different projects underway
- ~167 pieces of CHE
  - ✓111 **ZE** battery electric yard tractors
  - ✓2 **ZE** fuel cell electric yard tractors
  - ✓22 **NZE** natural gas ICE yard tractors
  - ✓10 **ZE** battery electric top handlers
  - ✓ 1 **NZE** fuel cell electric top handler
  - ✓9 **ZE** grid-connected RTGs
  - ✓12 **ZE** battery electric large capacity forklifts
- Most demonstrations are <u>just beginning to get started</u>
- More are on the way

Commercial Availability: Summary

- Yard Tractors
  - ✓**ZE Battery Electric**: Pre- to Early Commercial products
  - ✓**NZE NG:** Pre- to Early Commercial products
- RTGs
  - ✓**ZE Grid-Electric**: Commercial product
  - ✓**NZE Hybrid Diesel:** Commercial products
- Large Capacity Forklifts and Top Handler
  - No ZE or NZE commercial products yet available

Kalmar Ottawa Battery-Electric Yard Tractor

Kalmar NZE Hybrid-Electric RTG Crane

Technical Viability: Methodology and Criteria

- "Technology Readiness Level" (TRL) ratings
  - Technical progress
  - Overall readiness for broad commercial deployment by 2021
- Derived ratings from many verifiable sources
- Reality check: CARB's "Fuel and Technology Assessments"

Technical Viability: Summary – Yard Tractors

TRL	Relative Stage of Development	Late-2018 TRLs for Leading Fuel-Technology Platforms (Yard Tractors)	~2021: Educated Prognoses (by or before)	Comments / Basis for 2021 Educated Prognosis
TRL 9	**Systems Operations**			
TRL 8	**Systems Conditioning**		ZE Battery NZE NG ICE **(TRL 7 to 8)**	ZE Battery Electric / NZE NG ICE: strong OEM involvement and roll-outs of pre-commercial products; both platforms need significantly more operational time in real-world CHE service at Ports.
TRL 7		ZE Battery NZE NG ICE **(TRL 7)**		ZE Fuel Cell: biggest hurdles relate to total cost of ownership, including access to / on-board storage of hydrogen fuel; NZE Plug-in Hybrid: prognosis is a wild card; OEM interest is hard to gauge, but plug-in architecture enables valued partial zero-emission modes.
TRL 6	**Technology Demonstration**	ZE Fuel Cell or NZE PHEV **(TRL 5 to 6)**	ZE FC or NZE PHEV **(TRL 6 to 7?)** NZE Diesel ICE **(TRL 5 to 6, or higher?)**	
TRL 5	**Technology Development**	NZE Diesel ICE **(TRL 5)**		NZE Diesel ICE: could "leapfrog" to TRL 8 or 9, but only if suitable diesel engine(s) get certified to 0.02 g/bhp-hr NOx (or other CARB OLNS)
TRL 4				

Source: TRL methodology adapted from U.S. DOE, "Technology Readiness Assessment Guide, Table 1: Technology Readiness Levels, September 2011 (see footnote). TRL ratings estimated based on input from 1) OEM surveys, 2) various technical reports, 3) demonstration activities, and 4) meetings with agency technical personnel (CARB, CEC, SCAQMD).

Technical Viability: Summary – RTG Cranes

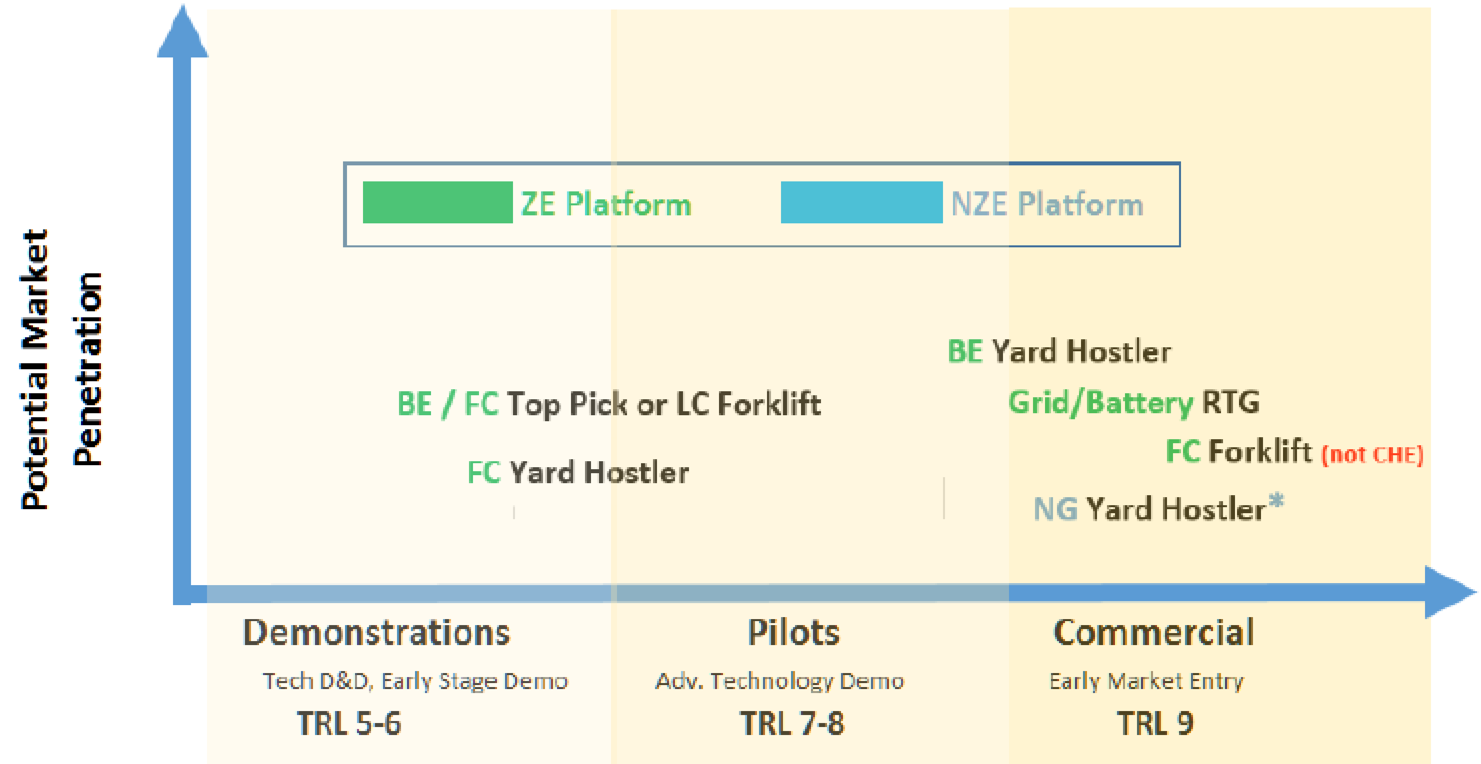
TRL	Relative Stage of Development	Late-2018 TRLs for Leading Fuel-Technology Platforms (RTG Cranes)	~2021: Educated Prognoses (by or before)	Comments / Basis for 2021 Educated Prognosis
TRL 9	Systems Operations	-ZE Grid Electric -NZE Diesel Hybrid (TRL 9)	-ZE Grid Electric -NZE Diesel Hybrid (TRL 9)	ZE Grid Electric and NZE Diesel Hybrid* are in final stages of development and sold commercially; demonstrations of 9 "E-RTG" (grid-electric) units will provide important MTO experience.
TRL 8	Systems Conditioning			*Hybrid: Emissions could be reduced significantly more by replacing diesel gen-set with one using OLNS-certified natural gas or propane engine.
TRL 7				
TRL 6	Technology Demonstration		ZE FC (TRL 6)	ZE Fuel Cell: One company sells FC option, implying TRL well above 5. TRL 6 and above requires working out challenges in an actual demonstration.
TRL 5	Technology Development	ZE FC (TRL 5)		
TRL 4				

Source: TRL methodology adapted from U.S. DOE, "Technology Readiness Assessment Guide, Table 1: Technology Readiness Levels, September 2011 (see footnote). TRL ratings estimated based on input from 1) OEM surveys, 2) various technical reports, 3) demonstration activities, and 4) meetings with agency technical personnel (CARB, CEC, SCAQMD).

Technical Viability: Summary – Forklifts and Top Handlers

- Top Handlers
  - ✓ZE **Battery Electric**: TRL 6, moving to TRL 7 by 2021
  - ✓ZE **Fuel Cell:** TRL 5, moving to TRL 6 by 2021
  - ✓NZE **PHEV:** TRL 5, moving to TRL 6 by 2021
- Large Capacity Forklifts
  - ✓ZE **Battery Electric**: TRL 6, moving to TRL 7 by 2021
  - ✓ZE **Fuel Cell:** TRL 5, moving to TRL 6 by 2021
  - ✓NZE **PHEV:** TRL 5, moving to TRL 6 by 2021

Reality Check: CARB Perspectives



NOTES: CARB does not specifically call-out Hybrid RTGs

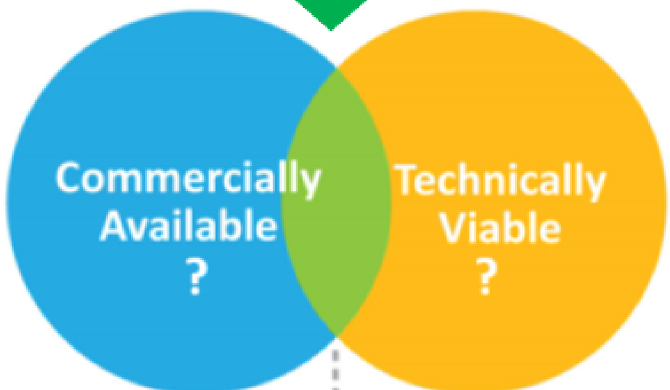
*CARB does not specifically call-out NG Yard Hostlers; it shows NZE NG engines

Source: Re-created from CARB Fig. 3, 4, 5 and 6; "Proposed FY 18-19 Funding Plan" (see text)

Screening Methodology

CHE Types (Any Main **ZE** and/or NZE Architecture) Receiving **Initial Screening**:

- Yard Tractors
- Top Handlers
- RTG Cranes
- Large-Capacity Forklifts



CHE Types / Specific Architectures for **Full Assessment**:

- ✓ **ZE Battery-Electric Yard Tractors**
- ✓ **NZE Natural Gas ICE Yard Tractors**
- ✓ **ZE Grid-Electric RTG Cranes**
- ✓ **NZE Hybrid-Electric RTG Cranes**

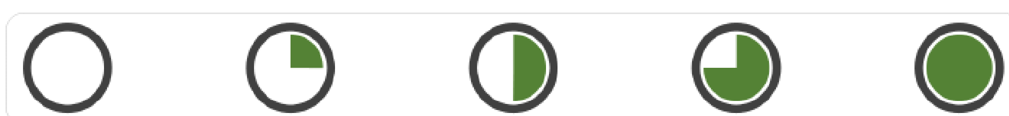
Operational Feasibility: Summary

- Basic Performance
- Fuel Economy and Endurance
- Speed and Frequency of Refueling/Recharging
- Operator Safety, Comfort, Refueling Logistics
- Availability of Replacement Parts and Support for Maintenance and Service

Operational Feasibility: Summary

"Operational Feasibility" Criteria	Base Considerations for Assessing "Operational Feasibility"	Yard Tractors		RTG Cranes	
		ZE BE	NZE NG ICE	ZE Grid-Electric	NZE Hybrid-Electric
Basic Performance	Demonstrated capability to meet MTO needs for basic performance parameters including power, torque, speed, operation of accessories, etc.	◑	●	●	●
Fuel Economy and Endurance	Demonstrated capability to achieve per-shift and daily operating time requirements found at San Pedro Bay terminals.	◔	●	●	●
Speed and Frequency of Refueling / Recharging	Demonstrated capability to meet MTO needs for speed and frequency to refuel / recharge such that revenue operation is not significantly reduced relative to diesel baseline.	◔	◕	◕	●
Operator Comfort, Safety, and Fueling Logistics	Proven ability to satisfy typical MTO needs for comfort, safety and refueling procedures.	◑	◕	●	●
Availability of Replacement Parts and Support for Maintenance / Training	Verifiable existence of and timely access (equivalent to baseline diesel) to all replacement parts needed to conduct scheduled and unscheduled maintenance procedures.	◑	◕	●	●

Legend: Operational Feasibility **(2018)**



Little/No Achievement — Fully Achieved

Source: Estimated ratings are based on MTO interviews and site visits, footnoted studies, OEM product information, various government sources, and consultant's industry knowledge.

Infrastructure Availability: Summary

- Time Required for Fueling/Charging
- Infrastructure Location and Footprint
- Infrastructure Buildout
- Existence of/Compatibility of Standards

Infrastructure Availability: Summary

"Infrastructure Availability" Criteria	Base Considerations for Assessing "Infrastructure Availability"	Yard Tractors		RTG Cranes	
		ZE Battery-Electric	NZE NG ICE	ZE Grid-Electric	NZE Hybrid-Electric
Time Required for Fueling/Charging	Fueling/charging can be accommodated within typical work breaks, lunches, other downtime compatible with MTO schedules and operational needs.	◔	◕	●	●
Infrastructure Location and Footprint	MTOs have existing onsite access to fueling infrastructure. New infrastructure can be installed without extensive redesign, reconfiguration or operational disruptions and there is sufficient utility capacity at the site.	◔	◕	◕	●
Infrastructure Buildout	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 fueling/charging. The fueling/charging technology has already been installed at other marine terminals in the U.S., with sufficient time to assess performance and safety.	◔	◕	●	●

Legend: Infrastructure Availability **(2018)**

○ ◔ ◑ ◕ ●

Little/No Achievement … Fully Achieved

Source: Estimated ratings are based on MTO interviews and site visits, footnoted studies, OEM product information, various government sources, and consultant's industry knowledge

Economic Workability: Summary

- Incremental Vehicle Cost
- Fuel and Other Operational Costs
- Infrastructure Capital and Operational Costs
- Potential Economic or Workforce Impacts
- Financing

Economic Workability: Cost of Ownership Results

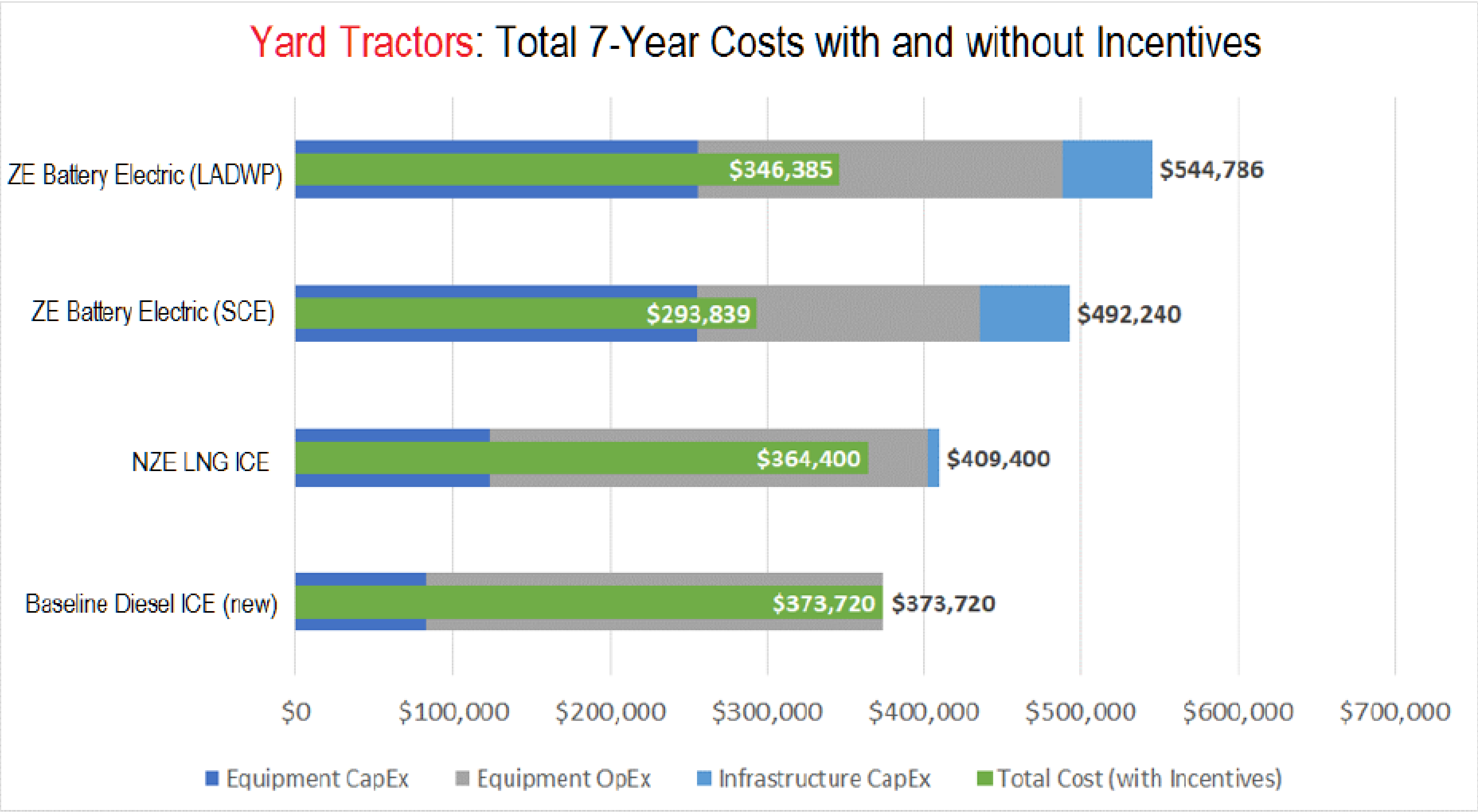


Figure 16. Total 7-year costs of ownership for "Average Yard Tractor" scenario (NPV at 7% discount rate)

Economic Workability: Cost of Ownership Results

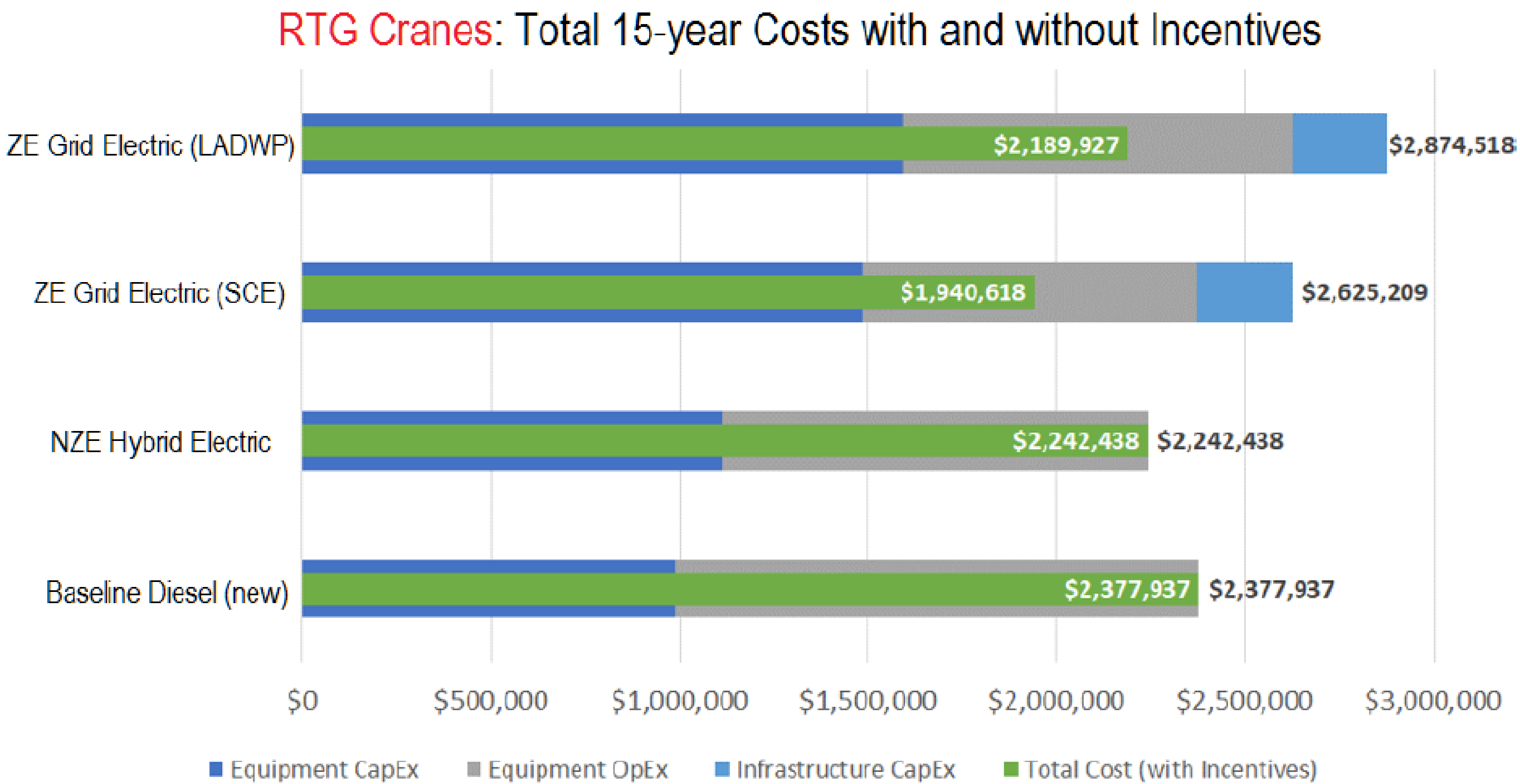


Figure 17. Total 15-year costs of ownership for the "Average RTG crane" scenario (NPV at 7% discount rate)

Economic Workability: Summary

"Economic Workability" Criteria	Base Considerations for Assessing "Economic Workability"	Yard Tractors		RTG Cranes	
		ZE BE	NZE NG ICE	ZE Grid-Electric	NZE Hybrid-Electric
Incremental Equipment Cost	The upfront capital cost for the new technology is affordable to end users, compared to the diesel baseline.	◔	◕	◑	●
Fuel and Other Operational Costs	The cost of fuel / energy for the new technology is affordable, on an energy-equivalent basis (taking into account vehicle efficiency). Demand charges / TOU charges (if any) are understood and affordable. Net operational costs help provide an overall attractive cost of ownership.	◑	●	◕	●
Infrastructure Capital and Operational Costs	Infrastructure-related capital and operational costs (if any) are affordable for end users.	◔	◑	◑	●
Potential Economic or Workforce Impacts to Make Transition	There are no known major negative economic and/or workforce impacts that could potentially result from transitioning to the new equipment.	◕	◕	◕	●
Existence and Sustainability of Financing to Improve Cost of Ownership	Financing mechanisms, including incentives, are in place to help end users with incremental equipment costs and/or new infrastructure-related costs, and are likely remain available over the next several years.	◕	◑	◕	●

Legend: Economic Workability (2018)

○ ◔ ◑ ◕ ●

Little/No Achievement — Fully Achieved

Source: Estimated ratings based on MTO interviews and site visits, footnoted studies, OEM product information, various government sources, and consultant's industry knowledge.

Incentives help but long-term availability and value is uncertain.

Overall Feasibility (2018): Summary

Feasibility Parameter	Yard Tractors		RTG Cranes	
	ZE Battery-Electric	NZE NG ICE	ZE Grid-Electric	NZE Diesel Hybrid-Electric
Commercial Availability	◑	◑	●	●
Technical Viability (TRL Rating out of 9)	TRL 7 (2021: TRL 7 to 8)	TRL 7 (2021: TRL 7 to 8)	TRL 9	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 parameter 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 CHE operations, the overall achievement ratings are based on the lowest criterion rating for each feasibility parameter.

Port of LONG BEACH The Green Port

THE PORT OF LOS ANGELES

Thank You

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Ocean-Going Vessel Retrofit Project Update

June 25, 2019

TAP Project Objective

To evaluate and quantify the environmental benefits of energy efficiency improvements for ocean-going vessels (OGV) using high-resolution data streams

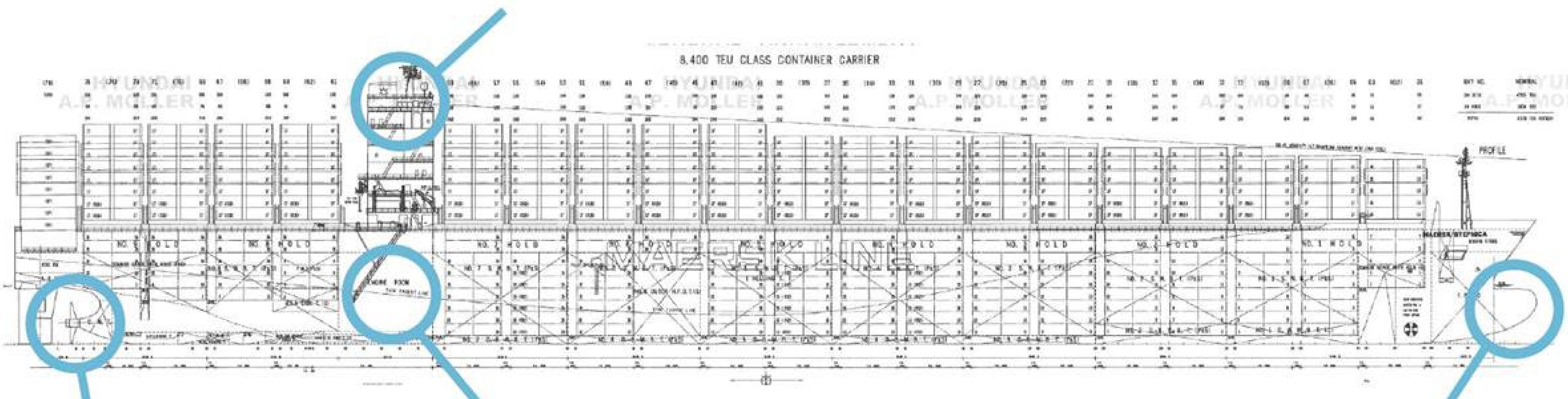
Key Project Points

- Maersk Invested Over $125 Million
  - Radical Retrofit
    - Modify Bulbous Bows
    - Improve Efficiency Propellers
    - Raise Bridge to Increase Capacity
    - De-rate Propulsion Engines
  - Connected Vessel Strategy
    - High Fidelity Data Collection

- Ports Invested $1 Million ($500K per Port)
  - TAP assisted in purchasing fuel flow meters, data acquisition and transmission, and data analysis

Radical Retrofit

Capacity utilisation
- *Elevation of navigation bridge (1-3 additional tiers)*
- *Installation of 'ballast water' tank*
- *Increase scantling draught*



Main engine
- *Engine derating*
- *Dynamic cylinder cut-out (Electronic engines)*

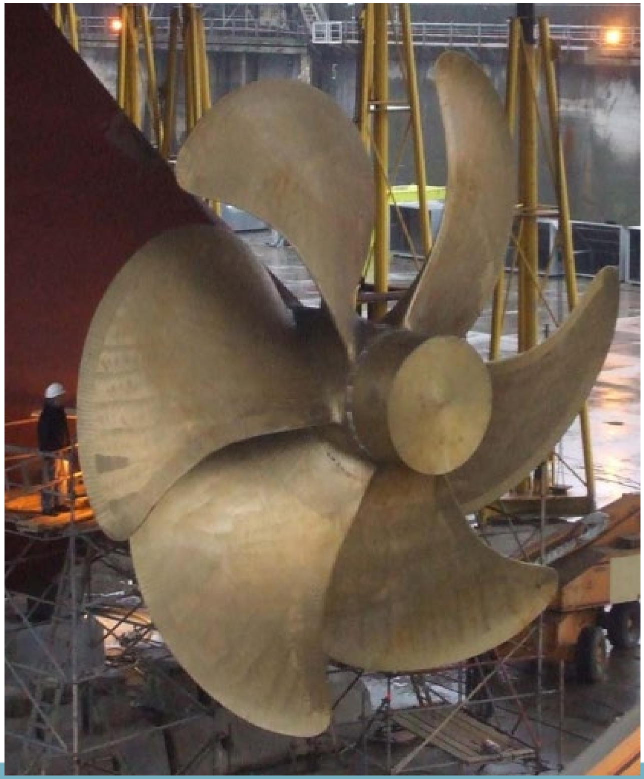
Bulbous Bow
- *Modification of bulbous bow*

Propulsion
- *New propeller designed for 16 knots and max 22 knots*
- *PBCF propulsion improvement device*

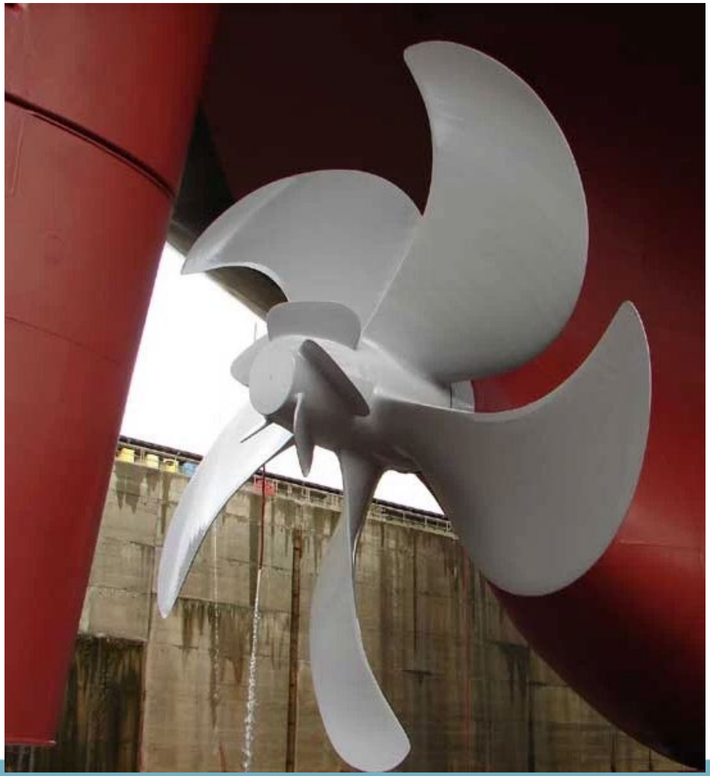
Bulbous Bow Modification

Propeller Replacement

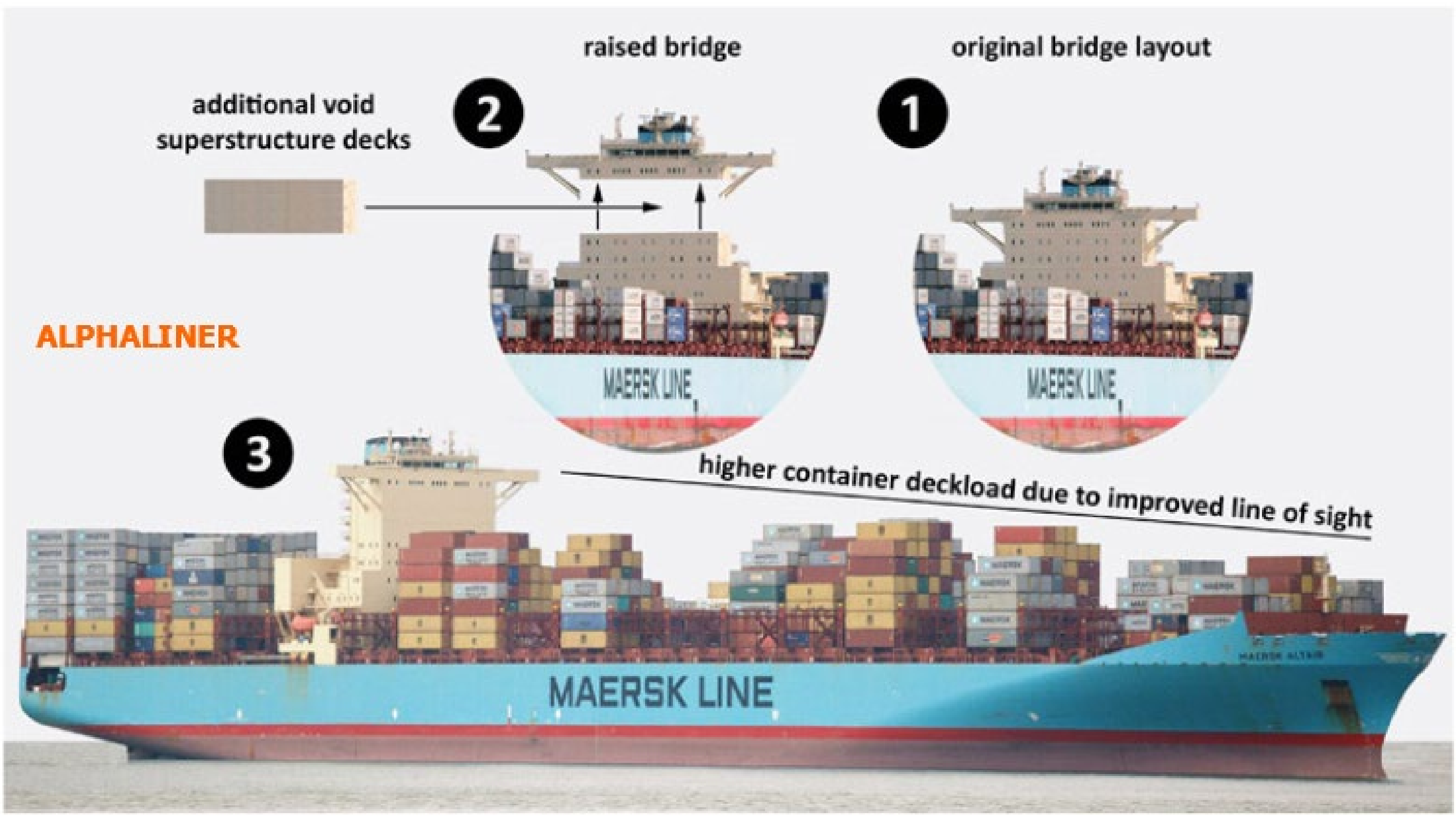
BEFORE



AFTER



Raised Bridge

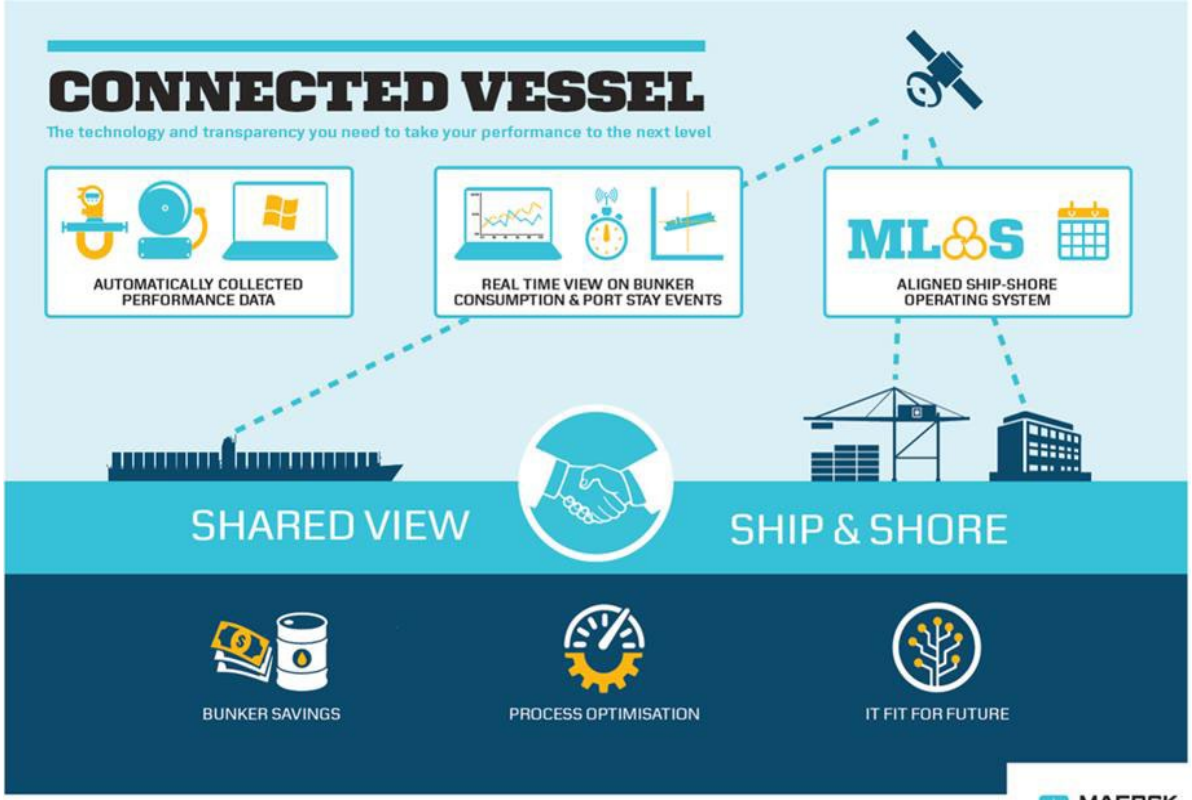


De-Rating Propulsion Engine

- Reduces engine output for lower maximum vessel speed
- Utilizes latest engine tuning methods
- Estimated 10-12% fuel savings based on new optimized speed

Connected Vessel Strategy

- The Connected Vessel Strategy
  - Automatically collects data
  - Provides a real-time view on fuel consumption and port stay events
  - Aligned ship and shore operating system



MAERSK LINE

High-Fidelity Data Collection & Data Analysis

- Installation of fuel meters and energy meters on each operating engine to measure fuel/energy consumption
- Data collection during port visits, by operational mode (open water transit, transition, maneuvering, at-berth), during arrivals and departures.
- Data collection prior to dry dock and after dry dock.
- Data collection at a high frequency (1 min intervals)

Challenges

- Technical challenges of the Project objective
- A company-wide cyber-attack in June 2017 that refocused Maersk project resources
- The cyber-attack also led to vessel data that was not accessible for a significant amount of time, as the company's Information Technology group worked to reestablish the company's systems and secure servers

Analysis, Approaches, and Results

- Three independent analyses incorporated a different technical approach:
  - Calculations from the independent analyses showed fuels savings up to 19%
  - More data still needs to be collected and analyzed
- Co-benefit
  - A 6 decibel change, which translates into a 75% reduction in underwater source sound pressure levels from the post-retrofitted ships

Conclusions and Recommendations

- Successful advancement of the understanding of new detailed data collection systems and instrumentation being deployed on ships
- Identified challenges associated with data security, logistics, and chain-of custody
- Identified significant uncertainties that need to be addressed as more detailed data streams come online
- Data continues to be collected and analyzed, with additional information submitted as an Addendum to the Final Report

The full report will be uploaded and available on the TAP website: http://www.cleanairactionplan.org/technology-advancement-program/

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CLEAN AIR ACTION PLAN

Status Update on Current Technology Demonstrations

June 25, 2019

POLA Grant-Funded Technology Demo - Update

Green Omni-Terminal Project

CARB $14.5 Million

STATUS UPDATE:

- 4 electric yard tractors
- 2 electric Class 8 trucks
- ShoreKat land-based at-berth emissions control system
- Solar rooftop array with microgrid controls and battery storage
- 3 electric forklifts

Shore to Store Project

CARB $41 Million

Various Partners off-Port Property

- 10 H_2-electric Class 8 trucks
- 2 heavy duty H_2 fueling stations
- 2 electric yard tractors with charging infrastructure (Port of Hueneme)
- 2 Zero-emission forklits

AID Project

CEC $7.8 Million

WBCT (China Shipping)

- 10 battery-electric yard tractors
- 12 Wireless charging stations
- Peak-shaving storage system

Advanced CHE Demonstrations

CEC $10.3 Million

Everport

- 20 RNG yard tractors
- 5 electric yard tractors, standard chargers
- 3 electric yard tractors, advanced charging system
- 2 electric top handlers

POLA Grant-Funded Technology Demo - Update

Green Omni-Terminal Project
CEC $14.5 Million

STATUS UPDATE:
- 4 electric yard tractors and chargers in use
- 2 on road trucks completed, being registered for operation
- ShoreKat system has been used on 3 ship calls
- Solar panels have been ordered.

Shore to Store Project
CARB $41 Million

STATUS UPDATE:
- First 5 trucks in development
- Equipment orders for H_2 stations submitted
- Infrastructure redesign at POH complete

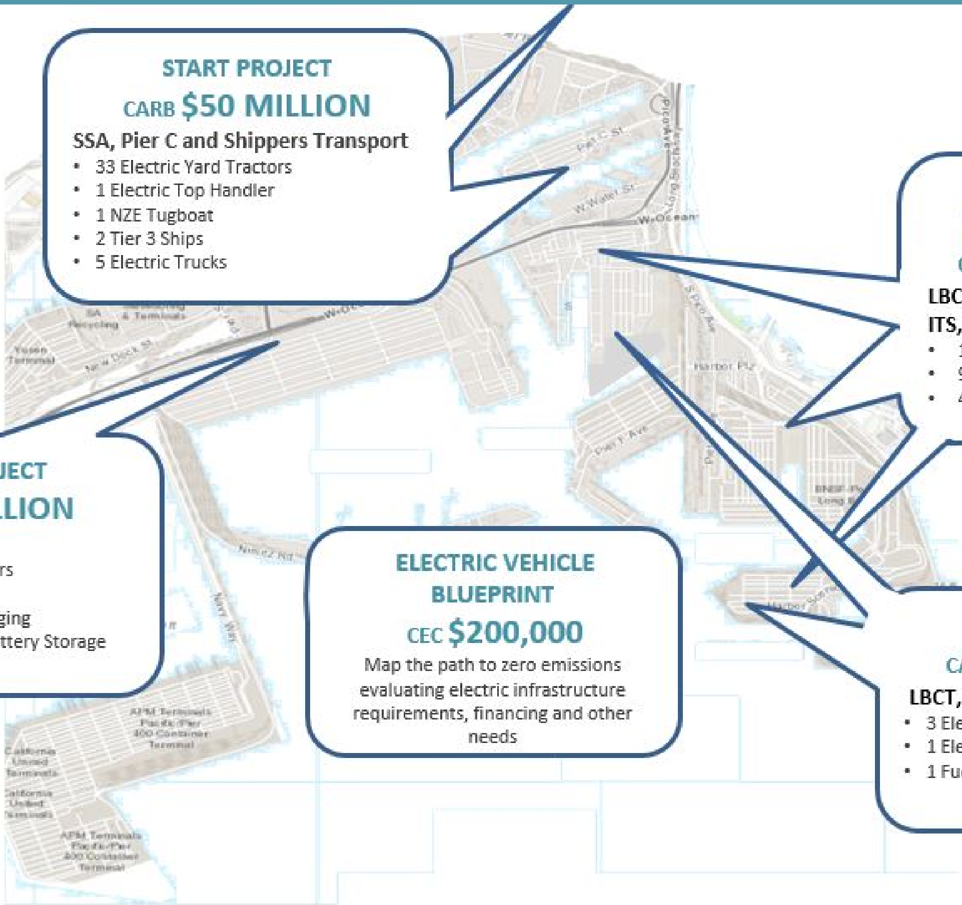
AID Project
CEC $7.8 Million

STATUS UPDATE:
- Contract approved
- Yard tractor manufacturer selected
- Initial design work underway

Advanced CHE Demonstrations: Eveport
CEC $10.3 Million

STATUS UPDATE:
- RNG Fueling equipment certified
- RNG and electric yard tractors scheduled for first deliveries this month
- 1 electric top handler has been delivered. 2nd will be delivered this month.

POLB Grant-Funded Technology Demo - Overview



START PROJECT

CARB **$50 MILLION**

SSA, Pier C and Shippers Transport
- 33 Electric Yard Tractors
- 1 Electric Top Handler
- 1 NZE Tugboat
- 2 Tier 3 Ships
- 5 Electric Trucks

ZE EQUIPMENT TRANSITION PROJECT

CEC **$9.75 MILLION**

LBCT, Pier E and SSA, Pier J and ITS, Pier G
- 12 Electric Yard Tractors
- 9 Electric RTG
- 4 LNG Hybrid Electric Trucks

PAVE PROJECT

CEC **$8 MILLION**

TTI, Pier T
- 6 Electric Yard Tractors
- 10 Electric Fork Lifts
- Install Electrical Charging Infrastructure and Battery Storage

ELECTRIC VEHICLE BLUEPRINT

CEC **$200,000**

Map the path to zero emissions evaluating electric infrastructure requirements, financing and other needs

C-PORT PROJECT

CARB **$5.3 MILLION**

LBCT, Pier E and SSA, Pier J
- 3 Electric Top Picks
- 1 Electric Yard Tractor
- 1 Fuel Cell Yard Tractor

POLB Grant-Funded Technology Demo - Update

START PROJECT

CARB $50 MILLION

STATUS UPDATE

- Applications submitted for Southern CA Edison Charge Ready Transport Program to support infrastructure installation at Port of Long Beach
- Purchase orders for Electric Yard Tractors fulfilled with manufacturing to begin soon
- First Matson Tier 3 OGV officially launched
- Demonstration Start: 2020

ZE EQUIPMENT TRANSITION PROJECT

CEC $9.75 MILLION

STATUS UPDATE

- LBCC ZE Port Equipment Workforce Assessment Final Report – COMPLETED
- BYD Electric Yard Tractors at facility ready to be delivered to LBCT and ITS
- Infrastructure underway at LBCT, Pier E
- Infrastructure completed with civil work underway at ITS, Pier G
- Infrastructure and civil work near completion at SSA, Pier J
- First of the nine eRTGs will be ready for service in August 2019
- US Hybrid LNG Hybrid Electric Trucks undergoing technology integration before delivery to TTSI
- Demonstration Start: Mid- to Late-Fall 2019

PAVE PROJECT

CEC $8 MILLION

STATUS UPDATE

- Infrastructure design underway at TTI, Pier T
- TransPower Energy Storage System design underway
- Data collection test plan development underway
- Demonstration Start: January 2021

ELECTRIC VEHICLE BLUEPRINT

CEC $200,000

COMPLETED

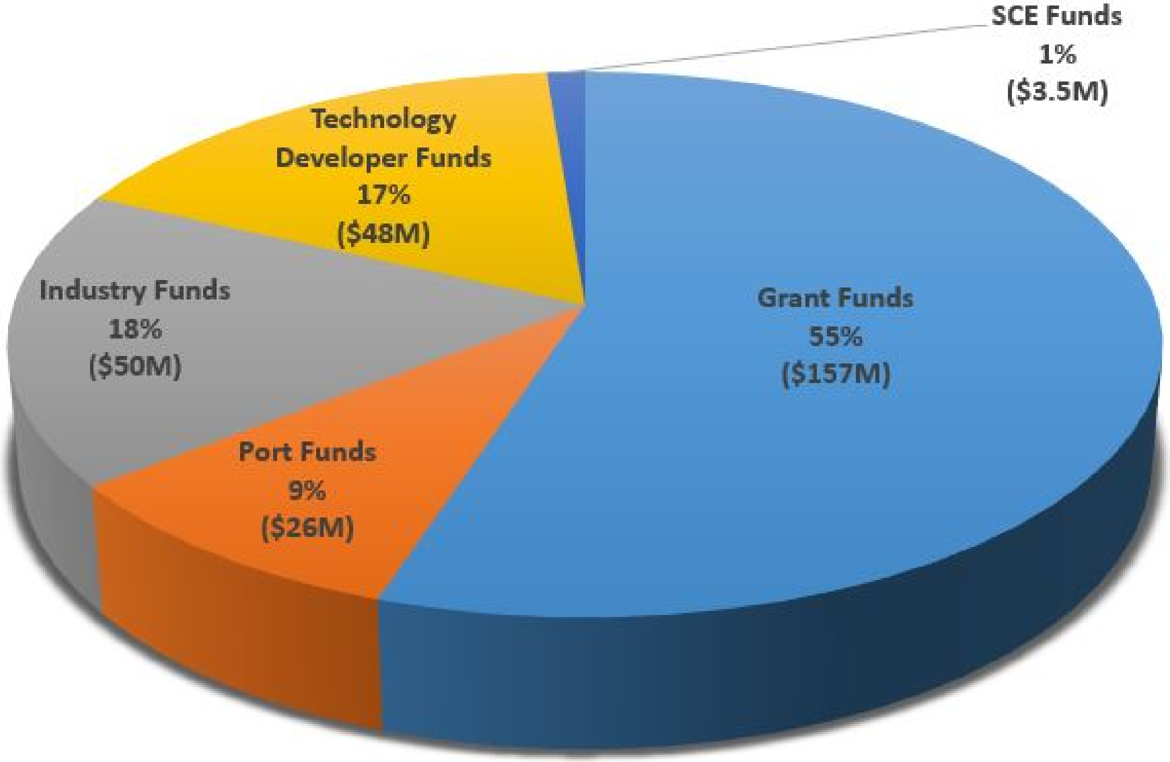
C-PORT PROJECT

CARB $5.3 MILLION

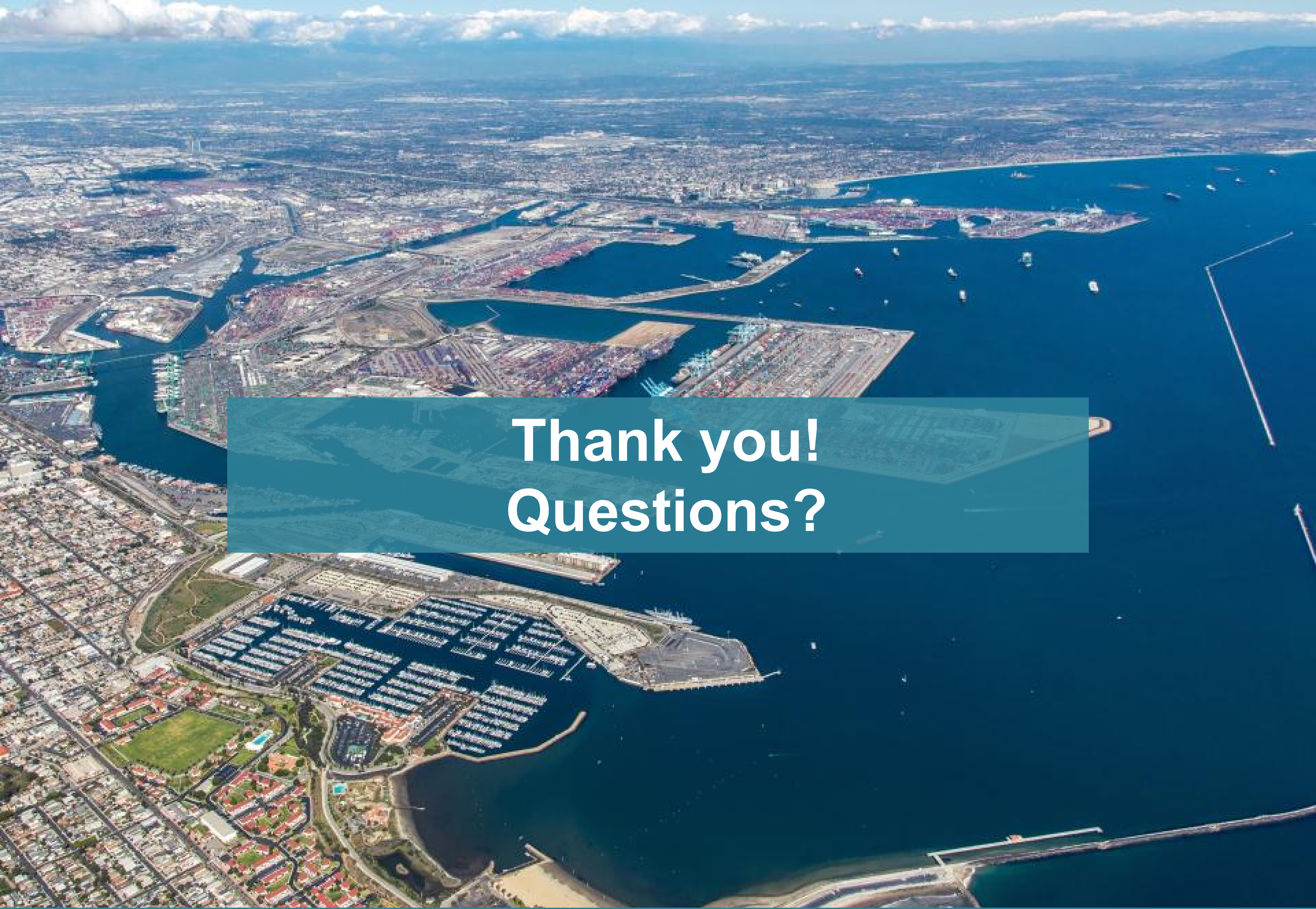
STATUS UPDATE

- Kalmar-TransPower Electric Yard Tractor has been delivered and training is underway at SSA, Pier J
- Hydrogen Fuel Cell Yard Tractor will be delivered in July 2019
- Taylor-BYD Electric Top Handlers will be delivered in 3rd Quarter 2019
- Infrastructure completed for TransPower EVSE and underway for BYD EVSE
- Demonstration Start: Fall 2019

Ports' Grant-Funded Technology Demo - Contributors



Total Cost as of June 2019 = $285M



Thank you!
Questions?