SAN PEDRO BAY PORTS

# CLEAN AIR ACTION PLAN

## Update on Technology Feasibility Assessments

**Chris Cannon**
Port of Los Angeles

**Heather Tomley**
Port of Long Beach

# Feasibility Assessments

- Cargo-Handling Equipment (CHE)
- Drayage Trucks

# Update

- Draft Drayage Feasibility Assessment public comment period ends **Wednesday January 23, 2019**
- Final Drayage Feasibility Report expected **Q1 2019**
- Draft CHE Feasibility Assessment expected to be publicly released **Q1 2019**

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# CLEAN AIR ACTION PLAN

## DRAFT 2018 FEASIBILITY ASSESSMENT of DRAYAGE TRUCKS

**December 2018**

## Presented at the Clean Air Action Plan Public Advisory Meeting

Patrick Couch

December 19, 2018

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**

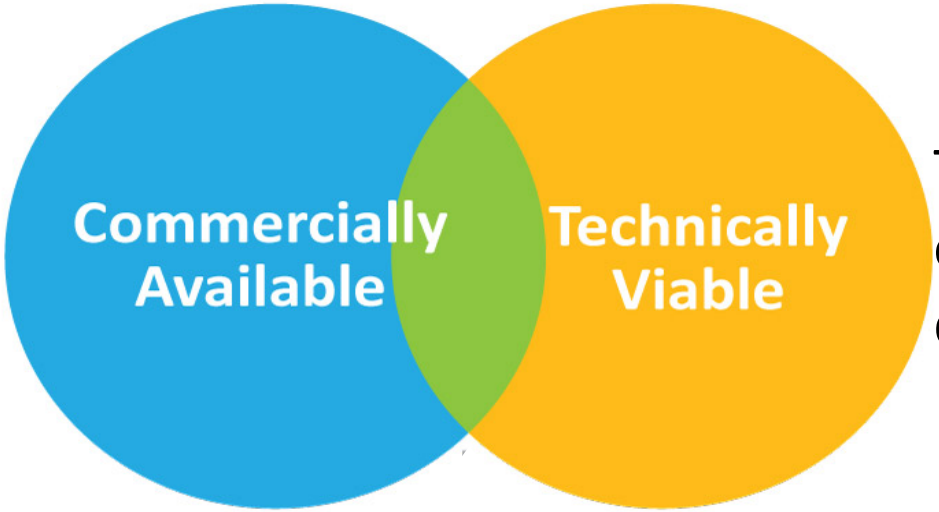
✓Technical reports, papers and literature resources

✓Key agencies (ARB, CEC, AQMD, Ports)

✓Surveys

# Screening Methodology

Currently available for commercial sale?




Technically capable of performing drayage service?

# Initial Characterization of Existing SPBP Drayage Fleet

**October 2018**

**18,193**

Registered Trucks

**13,239**

**Active** Trucks

**52%**

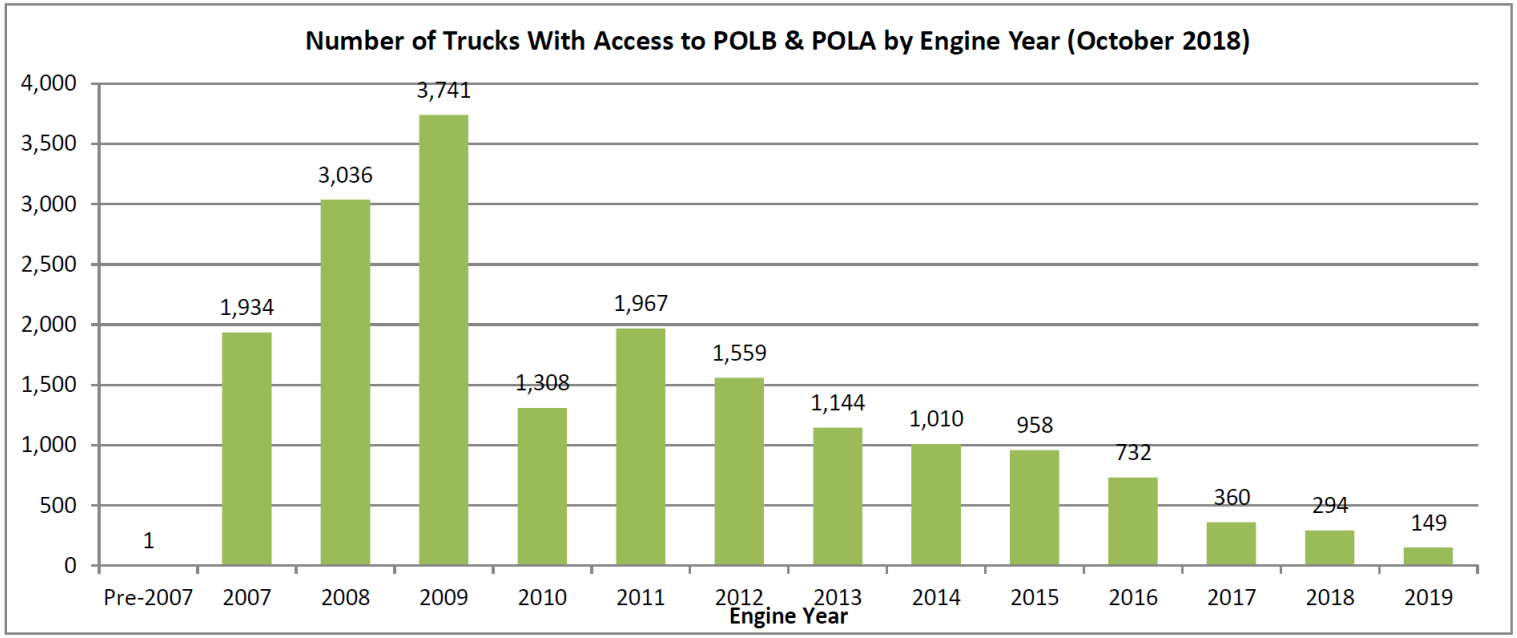
MY 2010+

**97%**

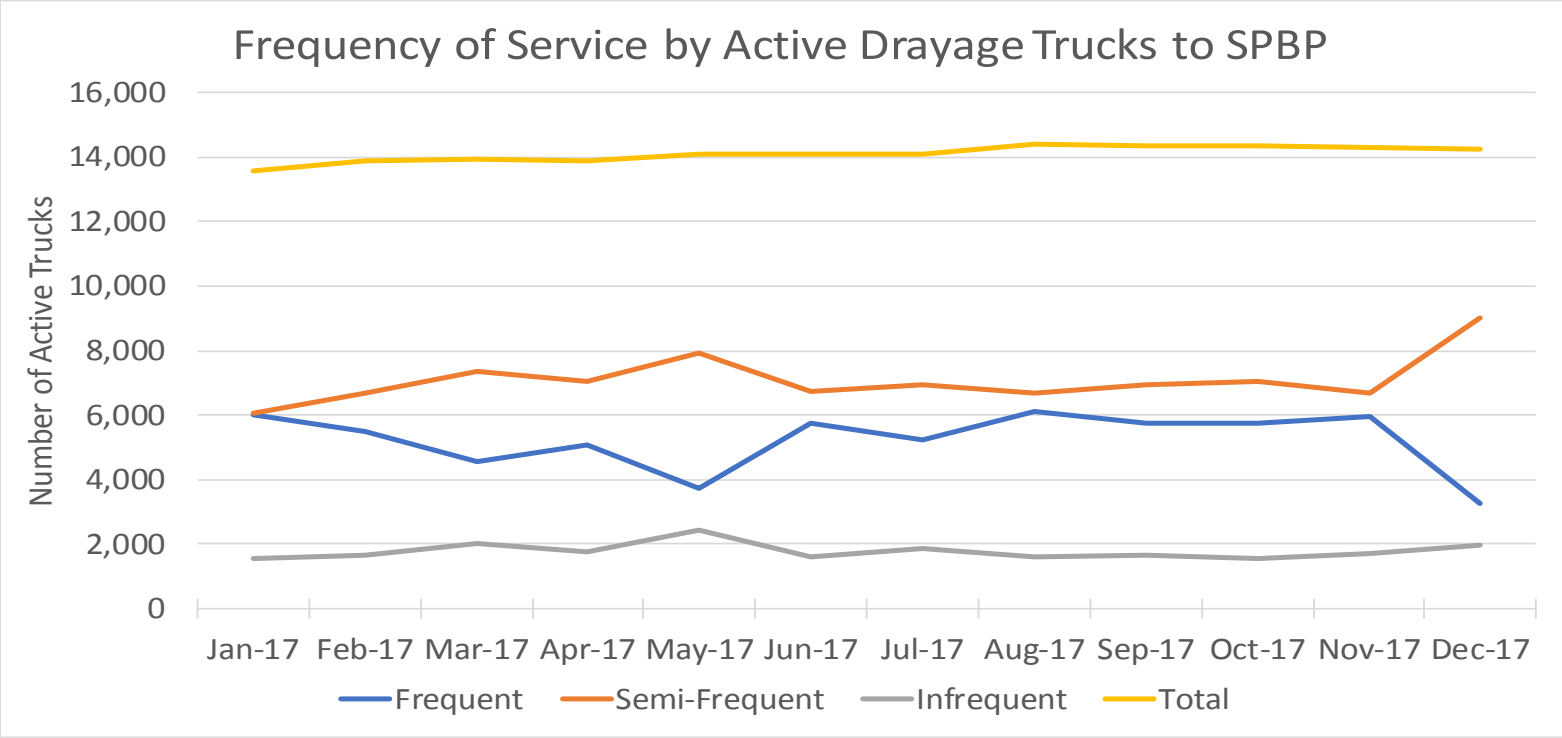
Conventional Diesel

**3%**

Natural Gas



# Initial Characterization of Existing SPBP Drayage Fleet




**18,000**

Trucks – High Estimate

**11,000**

Trucks – Low Estimate

# Defining Drayage Operational Requirements

Drayage consists of a broad range of operations:

- No official definition
- Some studies identified operational requirements
- Augmented with survey
  - 97 responses covering 3,300 port trucks

**“Broadly Applicable Truck”**

- High bar for technology
- Expected to cover most drayage activity
  - Some portion of drayage can be done by non-BAT trucks

# Commercial Availability: Methodology and Criteria

- A commercial drayage truck 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:**

- Survey of truck OEMs
- Publicly available OEM statements and specifications
- Technology demonstrations

# **Commercial Availability:** OEM Public Statements

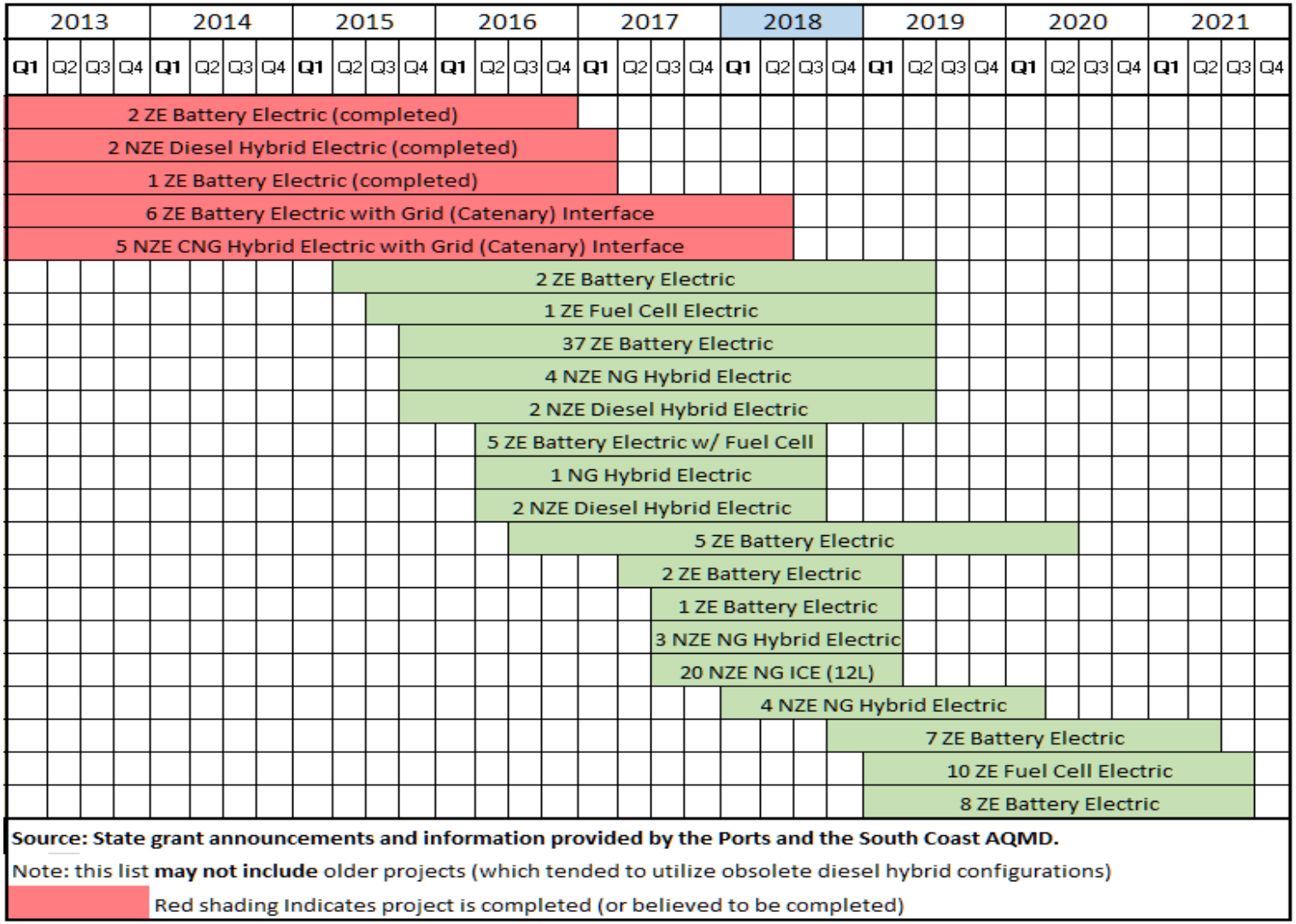
| Make | Model | ZE Battery-Electric | ZE Fuel Cell | NZE Hybrid Electric | NZE CNG | NZE LNG | Estimated Range** (mi.) |
|---|---|---|---|---|---|---|---|
| **BYD** | 8TT (T9/Q3M) | ✓ | × | × | × | × | 125 to 220 |
| **Freightliner (Daimler)** | Cascadia | × | × | × | ✓ | ✓ | 400 to 1,000 |
| **Kenworth** | T440 or T680 | | | | | | |
| **Mack** | Pinnacle | | | | | | |
| **Navistar Inc.** | Transtar 8600 | | | | | | |
| **Peterbilt*** | Model 579 | | | | | | |
| **Volvo** | VNL 300 | | | | | | |

# Commercial Availability:
## Pre/Early Commercial Demonstrations

- Mid-2018: ~20 different projects underway
- ~120 drayage trucks
  - ✓65 **ZE** battery electric
  - ✓16 **ZE** fuel cell electric
  - ✓12 **NZE** natural gas ICE / hybrid electric
  - ✓20 **NZE** natural gas ICE
  - ✓ 7 **NZE** diesel ICE / hybrid electric
- Most demonstrations are <u>just beginning to get started</u>
- More are on the way

# Commercial Availability:

## Pre/Early Commercial Demonstrations




**Source: State grant announcements and information provided by the Ports and the South Coast AQMD.**

Note: this list **may not include** older projects (which tended to utilize obsolete diesel hybrid configurations)

Red shading Indicates project is completed (or believed to be completed)

# **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"
  - ✓ North American Council for Freight Efficiency (NACFE)
  - ✓ SCAQMD 2018 Clean Fuel Program Plan Update

# **Technical Viability:** Summary (Leading Platforms)

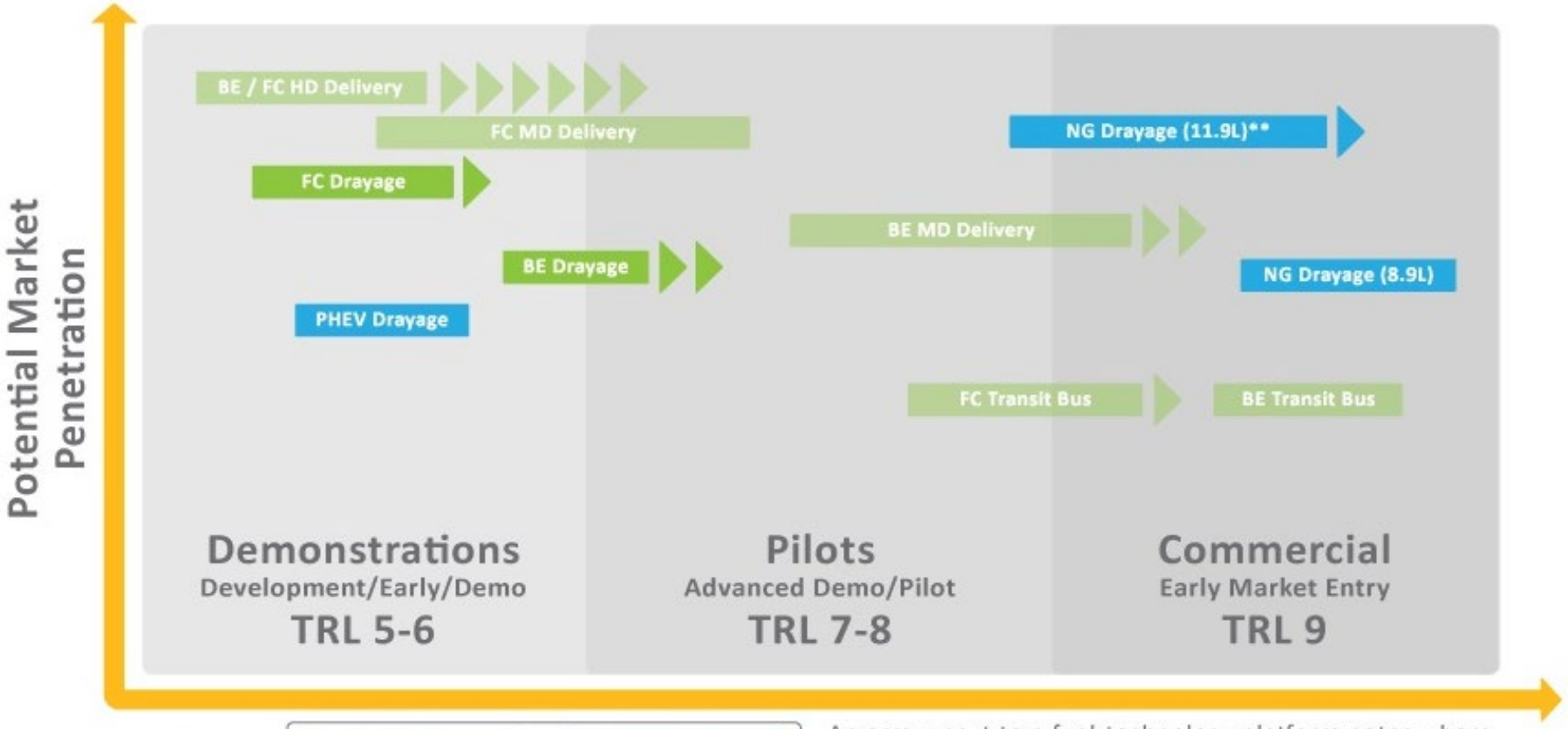
| TRL | Relative Stage of Development | Late-2018 TRLs for Leading Fuel-Technology Platforms (Drayage) | ~2021: Educated Prognoses (by or before) | Comments / Basis for 2021 Educated Prognosis |
|---|---|---|---|---|
| **TRL 9** | **Systems Operations** | | **NZE NG ICE (TRL 9)** | **NZE NG ICE:** to reach TRL 9 in Class 8 port drayage, new NZE 12-liter engine needs operational time |
| **TRL 8** | **Systems Conditioning** | **NZE NG ICE (TRL 8)** | **ZE Battery (TRL 8)** | **ZE Battery Electric:** strong progress in transit bus / MDV sectors is likely to advance Class 8 drayage use; ongoing range challenge may limit to short-haul applications |
| **TRL 7** | | **ZE Battery (TRL 6 to 7)** | **ZE Fuel Cell or NZE Plug-in Hybrid (TRL 7??)** | **ZE Fuel Cell:** biggest remaining 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 "zero-emission mile" capability |
| **TRL 6** | **Technology Demonstration** | **ZE Fuel Cell or NZE Plug-in Hybrid (TRL 5 to 6)** | **NZE Diesel ICE (TRL 5, 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).

# **Reality Check:** CARB, NACFE, and SCAQMD Perspectives

- CARB
  - ✓**ZE BE** drayage trucks: **TRL 6 to 7**
  - ✓**ZE FC** drayage trucks: **TRL 5 to 6**
  - ✓**NZE NG** drayage trucks (12L): **TRL 9**
- NACFE report findings:
  - BE drayage trucks will not achieve parity for "Overall Technology Maturity" or "Initial Cost" until beyond 2030
- SCAMQD Clean Fuels Program
  - RNG + 11.9L NZE engine more cost effective pathway to near-term NOx and GHG reductions
  - Significant implementation of BE and FCV technology not anticipated for the next ten years

# **Reality Check:** CARB, NACFE, and SCAQMD Perspectives




An arrow next to a fuel-technology platform notes where CARB staff observed "directional changes in commercialization status" since its 2017 update.

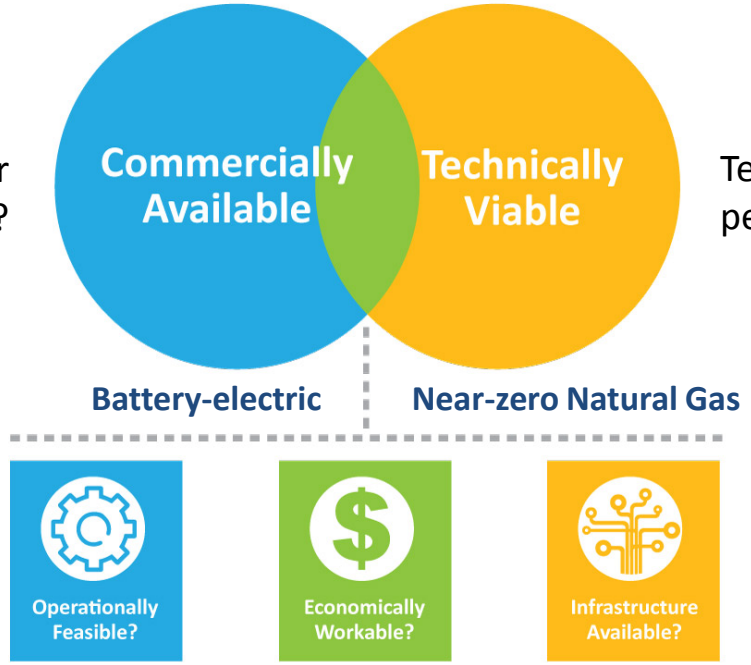
** Suitable for all drayage duty cycles including regional, as well as "some line haul trucking"

**Sources:**

Adapted from CARB Figures 3, 4, 5 and 6, in California Air Resources Board, "Proposed Fiscal Year 2018-19 Funding Plan for Clean Transportation Incentives for Low Carbon Transportation Investments and the Air Quality Improvement Program," September 21, 2018, *https://www.arb.ca.gov/msprog/aqip/fundplan/proposed_1819_funding_plan.pdf*. Page D-5 to D-19.

# Screening Methodology

Currently available for commercial sale?




Technically capable of performing drayage service?

# **Operational Feasibility:** Summary

- Basic Performance
- Range
- Speed and Frequency of Refueling/Recharging
- Driver Safety, Comfort, Refueling Logistics
- Availability of Replacement Parts and Support for Maintenance and Service

# **Operational Feasibility:** Summary

| Operational Feasibility Criteria / Parameter | Base Considerations for Drayage Platforms to Achieve Operational Feasibility | Achievement of Criteria in 2018 for Commercially Available Drayage Truck Platforms | |
|---|---|---|---|
| | | ZE Battery-Electric | NZE NG ICE |
| **Basic Performance** | Demonstrated capability to meet drayage company needs for basic performance parameters including power, torque, gradeability, operation of accessories, etc. |  |  |
| **Range** | Demonstrated capability to achieve per-shift and daily range requirements found in San Pedro Bay drayage. |  |  |
| **Speed and Frequency of Refueling / Recharging** | Demonstrated capability to meet drayage company needs for speed and frequency to refuel / recharge such that revenue operation is not significantly reduced relative to diesel baseline. |  |  |
| **Driver Comfort, Safety, and Refueling Logistics** | Proven ability to satisfy typical drayage trucking company's 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. |  |  |
| | Verifiable existence of maintenance procedure guidelines and manuals, including OEM-provided training courses upon purchase and deployment of new trucks. |  |  |

**Legend:** Operational Feasibility **(2018)**


**Source:** Based on Drayage Truck Operator Survey responses, footnoted studies, OEM product information, and consultant's industry knowledge.

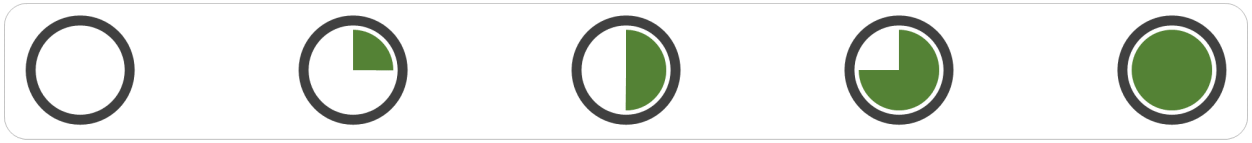
# **Infrastructure Availability:** Summary

- Dwell Time at Station
- Station Location and Footprint
- Infrastructure Buildout
- Existence of/Compatibility of Standards

# Infrastructure Availability: Summary

| 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. |  |  |
| **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 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. |  |  |

Legend: **Infrastructure Availability (2018)**



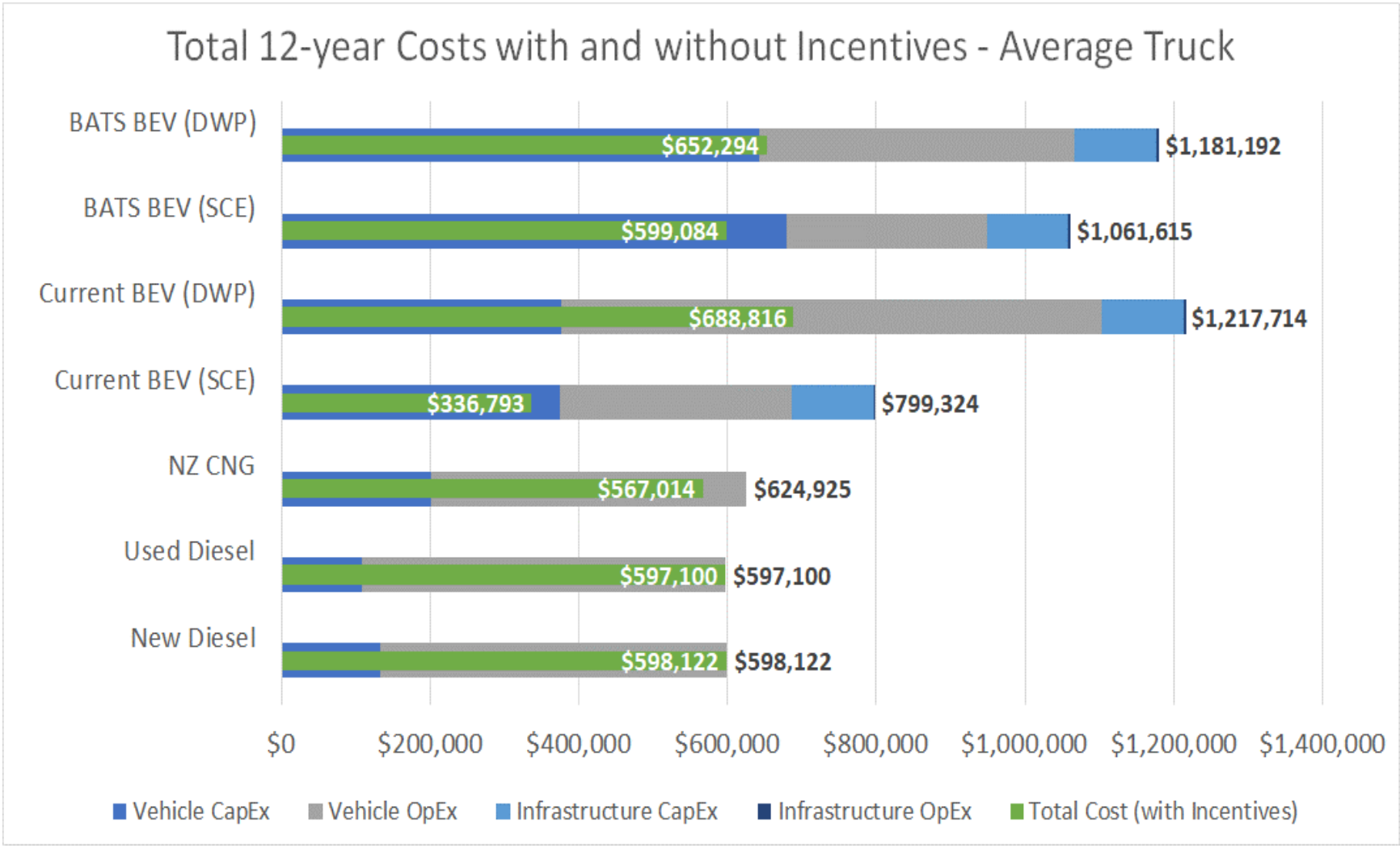
Little/No Achievement — Fully Achieved

**Source:** based on preliminary OEM survey responses, OEM product information, various government sources, and Tetra Tech team'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



# Economic Workability: Summary

| Economic-Related Criteria / Issue | Base Considerations for Assessing General Economic Workability | Achievement of Criteria in 2018 (Commercially Available Truck Platforms) | |
|---|---|---|---|
| | | ZE Battery-Electric | NZE NG ICE |
| **Incremental Vehicle 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 vehicle 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:** based on preliminary OEM survey responses, OEM product information, various government sources, and Tetra Tech team's industry knowledge.

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

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## Thank You

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# CLEAN AIR ACTION PLAN

## Clean Truck Program - 4th Quarter 2018 Update

**Tim DeMoss**
Air Quality Supervisor
Port of Los Angeles

# CTP Implementation

- 2018 Tariff Modification
  - Only allow MY 2014 trucks to newly register in the PDTR
    - Took effect October 1, 2018
    - Existing Fleet was Grandfathered


# CTP Rate Study

- Truck Rate Study Goals
  - Analyze potential for cargo diversion over range of rates
  - Analyze potential effect on the local drayage industry
  - Project potential revenues that might be generated over range of rates


# CTP Rate Study

- Process and Schedule
  - Selected Davies Transportation Consulting, Inc.
  - Study launched in Q4 2018
  - Estimated completion Q2 2019

# Rate Collection Mechanism

- Ports plan to release a Request for Proposals (RFP) in Q1 2019
  - Compiling a list of potential Proposers
- RFP will contain minimum requirements to collect a rate from the Beneficial Cargo Owners
- Plan to hold a Workshop 2 weeks before the RFP is released

# CTP Early Action

- Low NOx Truck Early Deployment Program
  - CEC grant secured by AQMD
    - Total budget $14M ($8M CEC grant, plus $2M each from AQMD, POLA, and POLB)
    - Up to 140 Low NOx Trucks
    - Launching in 2019
  - Ports' Boards of Harbor Commissioners approved the budget requests ($2 Million per Port)

# CTP Technology Demonstration

- Large-Scale Zero Emission Truck Deployment Pilot Project
  - Purpose and Scope
    - Deploy 50 to 100 zero emission trucks
    - Evaluate the ability of a trucking company to integrate a larger deployment of zero emission trucks into their daily operations
    - Evaluate the ability of truck manufacturers to produce and support large numbers of zero emission trucks
    - Evaluate infrastructure requirements to support larger deployments of zero emission trucks

# CTP Technology Demonstration

- Large-Scale Zero Emission Truck Deployment Pilot Project
  - Process and Schedule
    - ✓ Trucking Fleet Survey to assess interest and needs
    - ✓ Working group meeting
    - ✓ RFI to truck manufacturers
    - ❑ Finalize Scope of Work/Concept Paper
    - ❑ **Secure Funding**
    - ❑ Issue RFP

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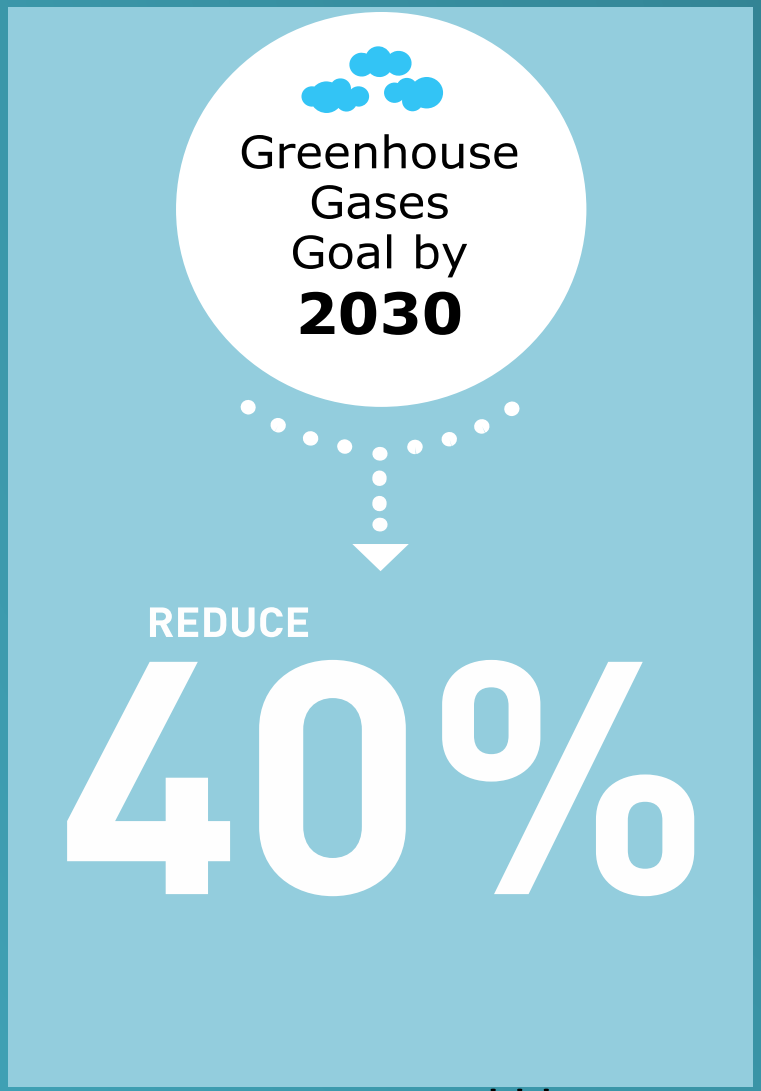
## GHG Baseline Inventory

**Jacqueline Moore**
Port of Long Beach

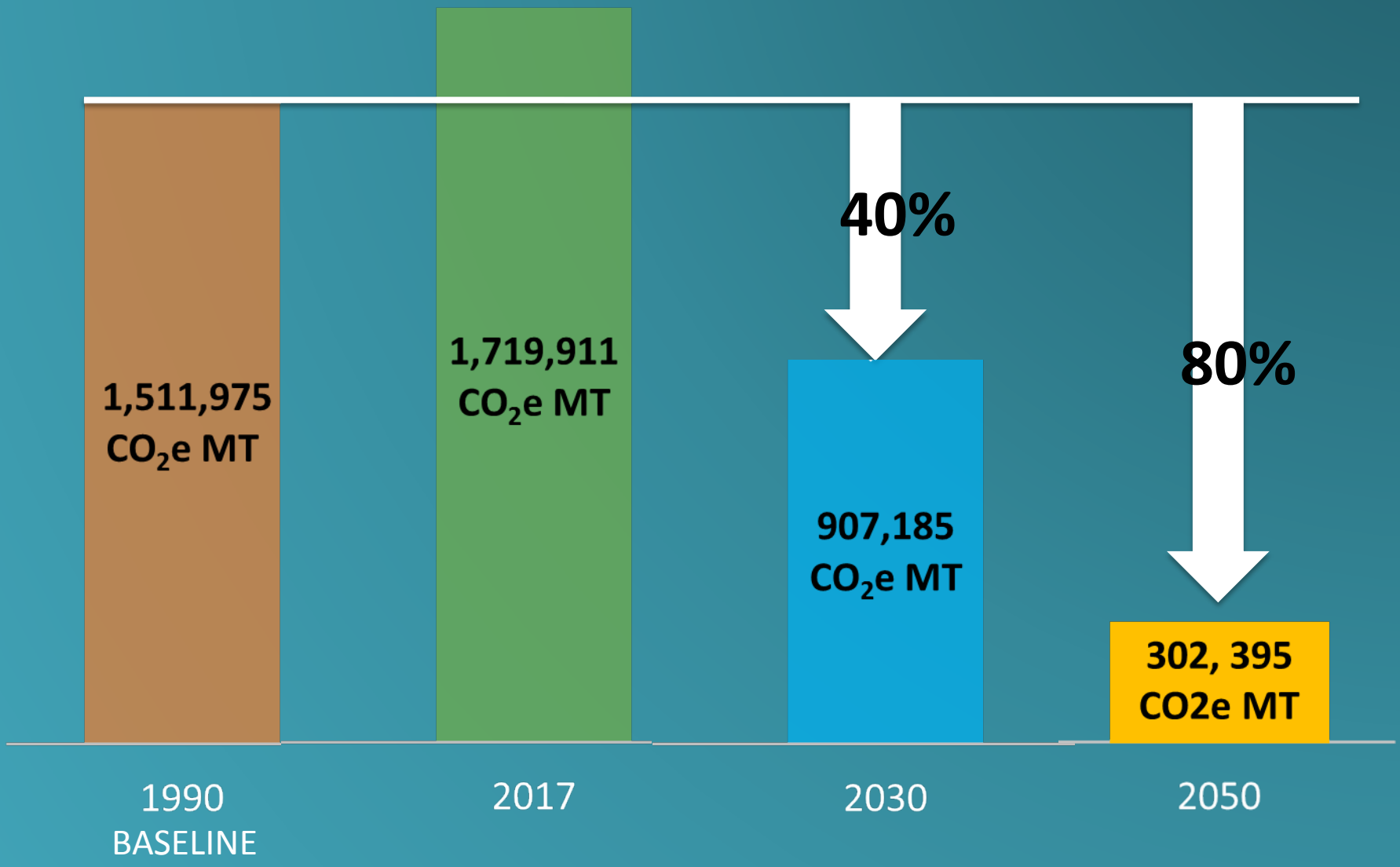
# GHG Reduction Goals





***compared to 1990 levels

# GHG Baseline



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# CLEAN AIR ACTION PLAN

## Looking Ahead to 2019

**Renee Moilanen**
Port of Long Beach

# 2019 Actions

- Technology Advancement Program
- Early Near-Zero and Zero-Emissions Truck Deployments
- Harbor Craft

# TAP Annual Report


www.cleanairactionplan.org/tap

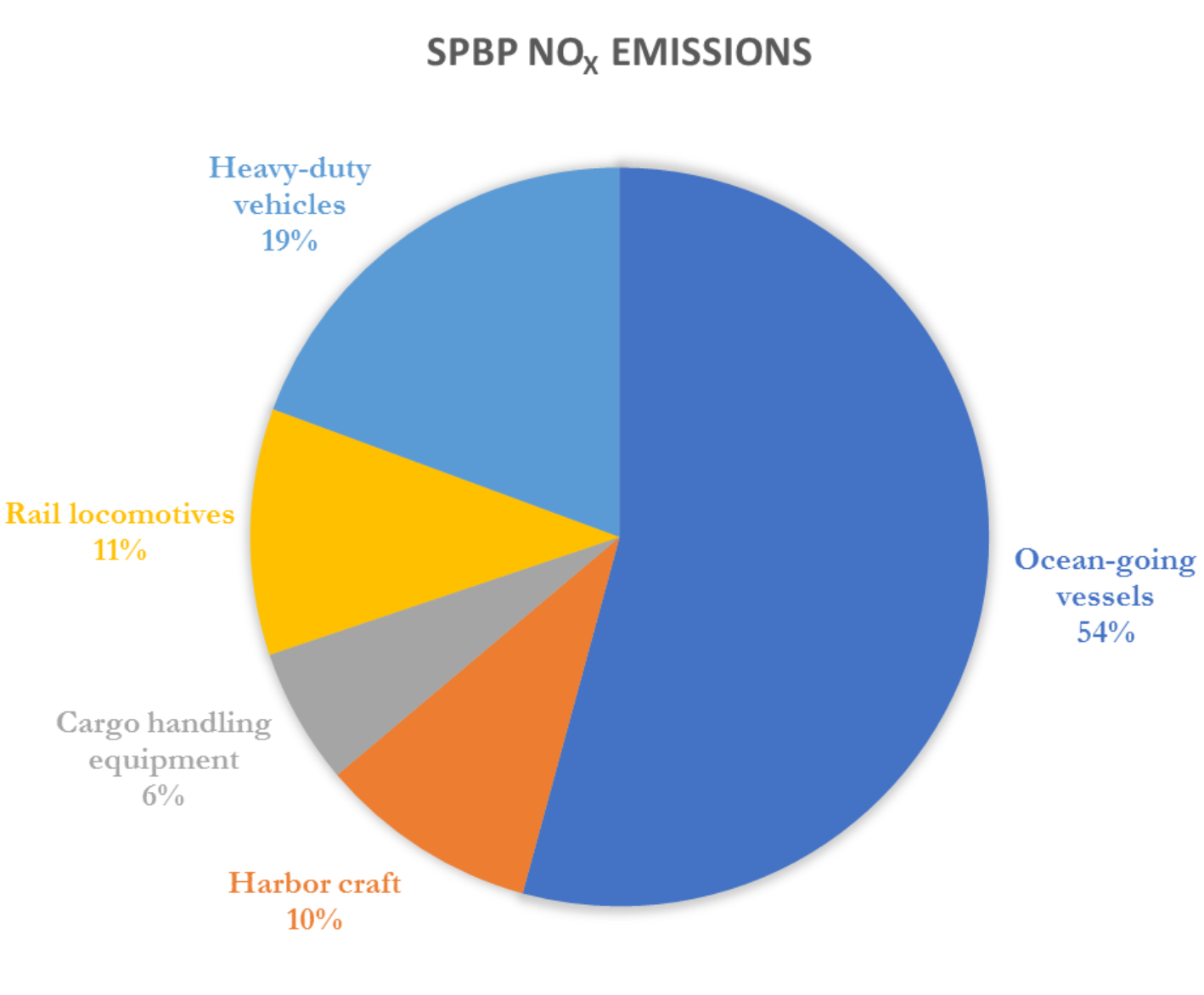
# Early Truck Action

- Near-zero natural gas truck deployment
- Zero-emissions demonstrations
- New funding and outreach in Q1 2019

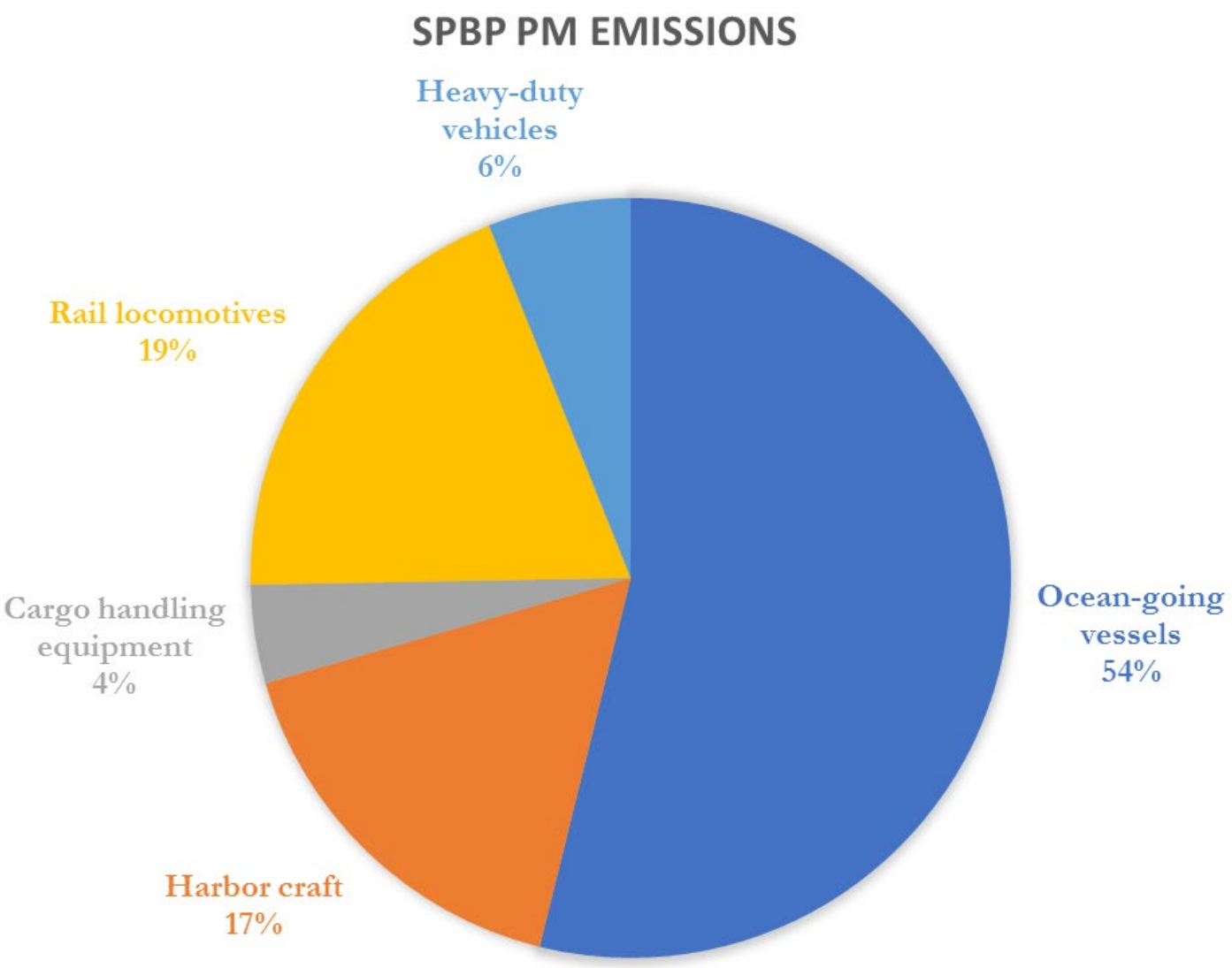
# Harbor Craft


## Need + New Opportunities

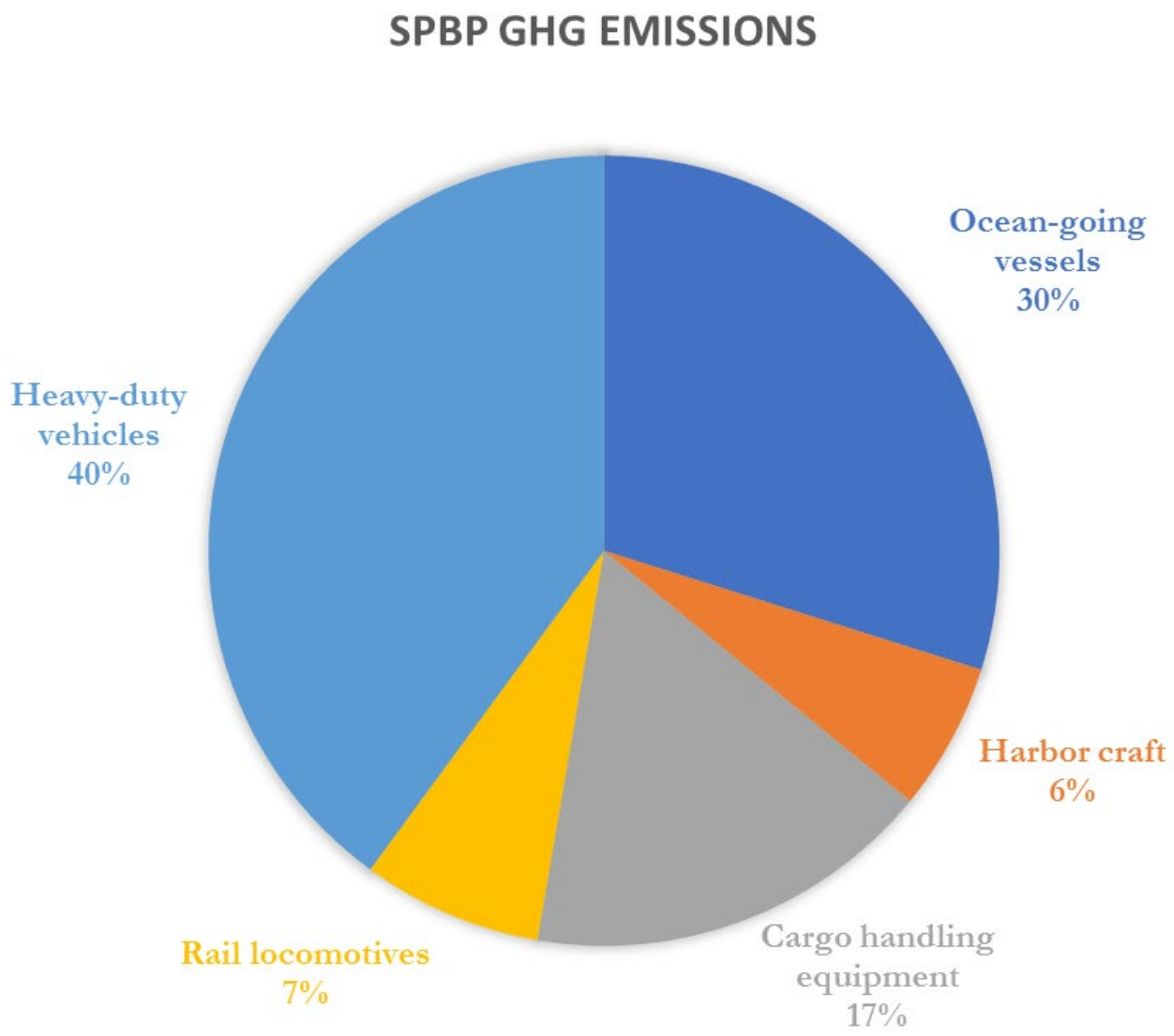
# SPBP NOx Emissions



# SPBP PM Emissions



# SPBP GHG Emissions



# Opportunities

- CARB Harbor Craft Rulemaking
- Incentive Funding
- Technology Advancement

# Clean Harbor Craft Program


- Outreach
- Grants for Tier 4
- Demonstrations


More information:
www.cleanairactionplan.org