



Cost Assessment for the *Draft 2020 and Beyond Plan*

Krystle McBride, AECOM

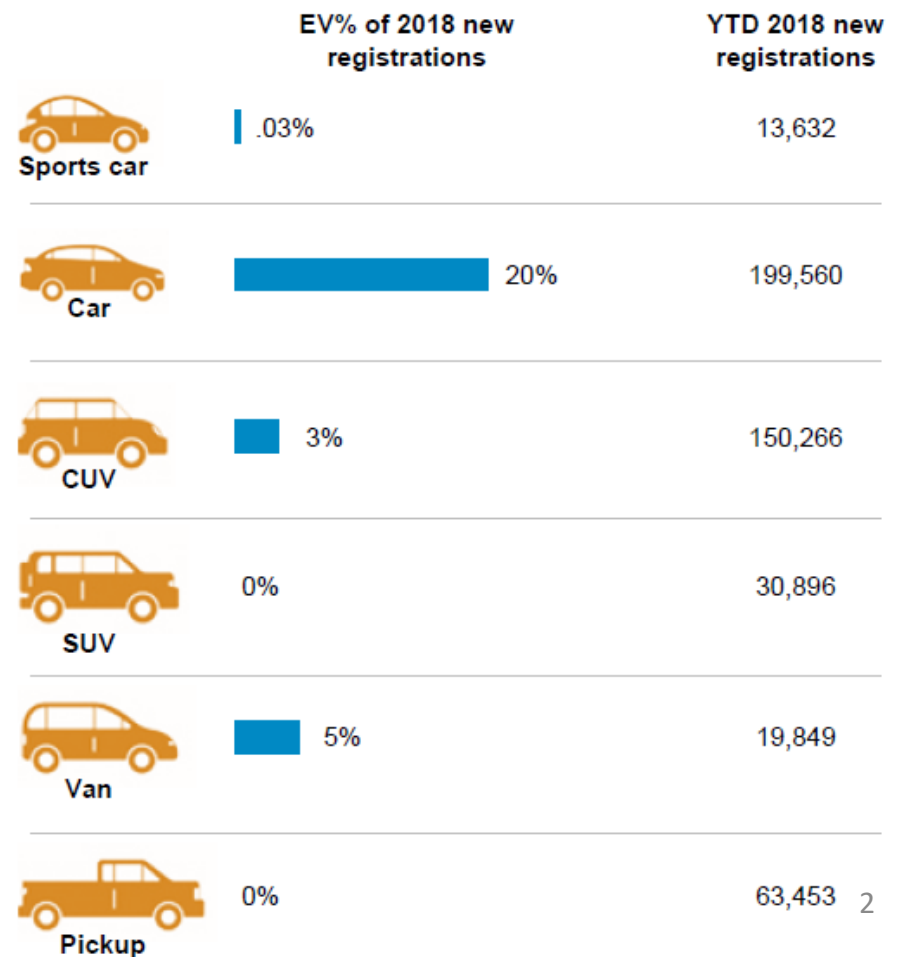
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Battery-Electric Vehicles Adoption in CA

Examples: cars and buses

- ~150 battery-electric buses operate in CA today (of ~12,000 total state-wide fleet)
- CARB has set a goal of 100% zero-emission buses for public transit agencies by 2040, with 100% EV for new purchases by 2029

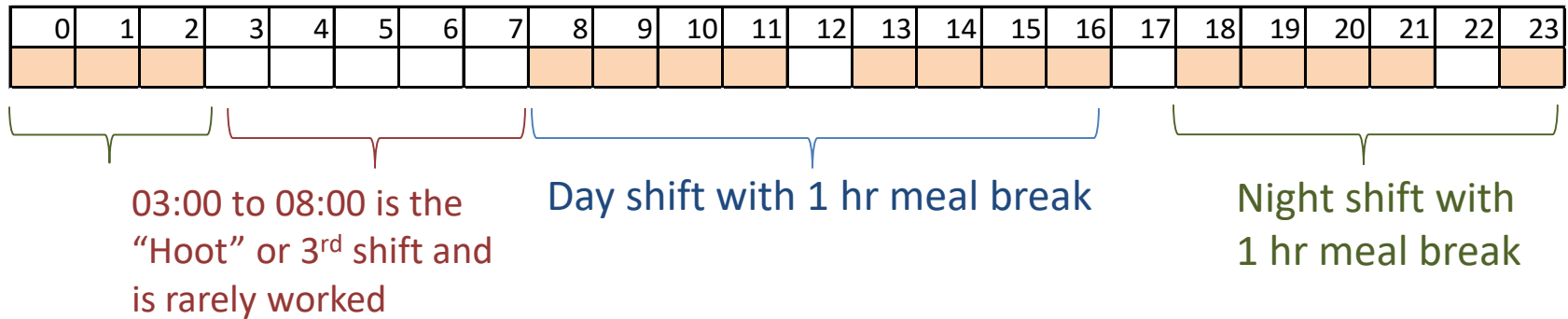
EVs make up 9% of new car registrations in PG&E's service area this year, but **within vehicle classes, there is a wide disparity of EV uptake**



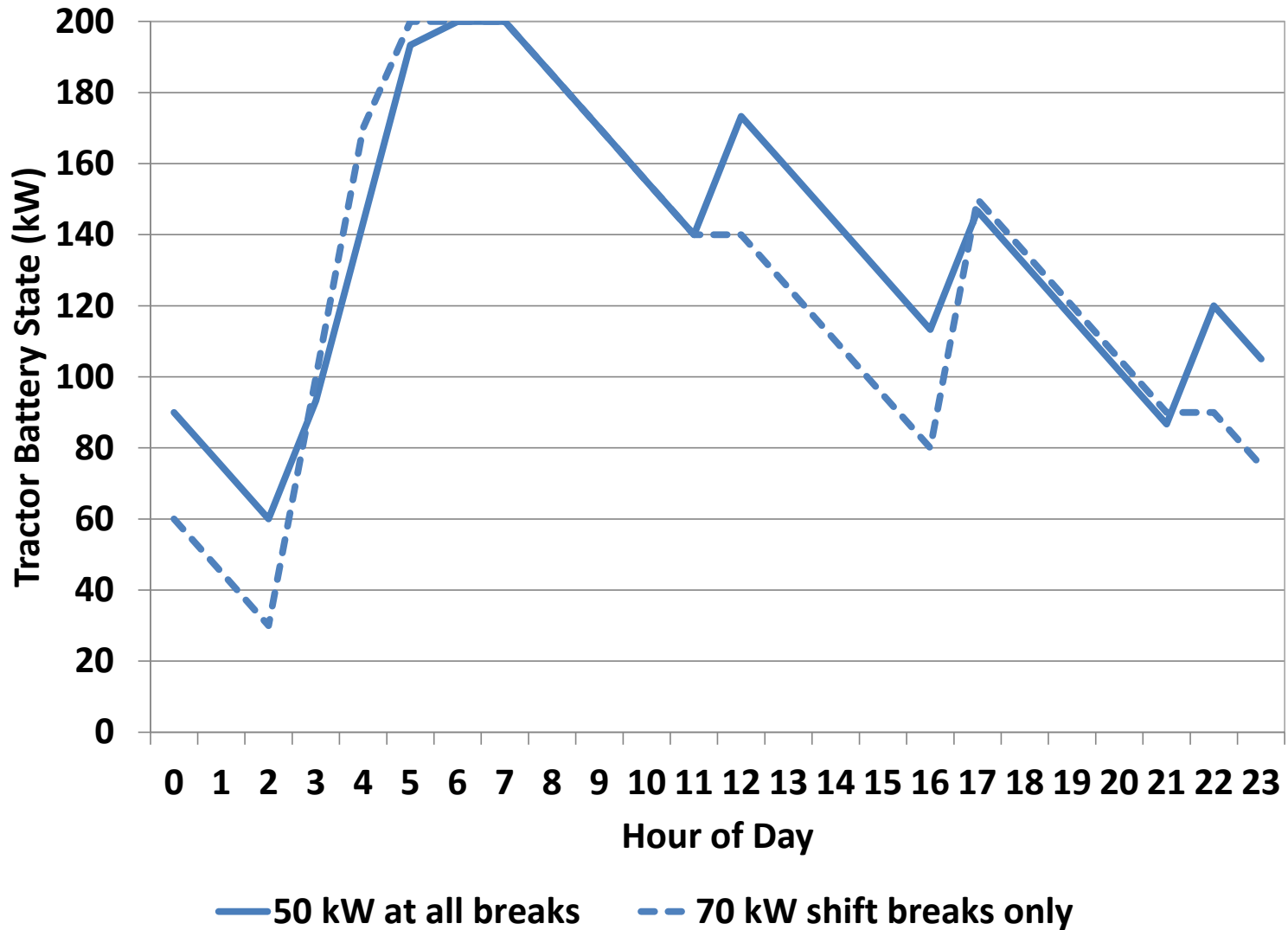
Port of Oakland Seaport



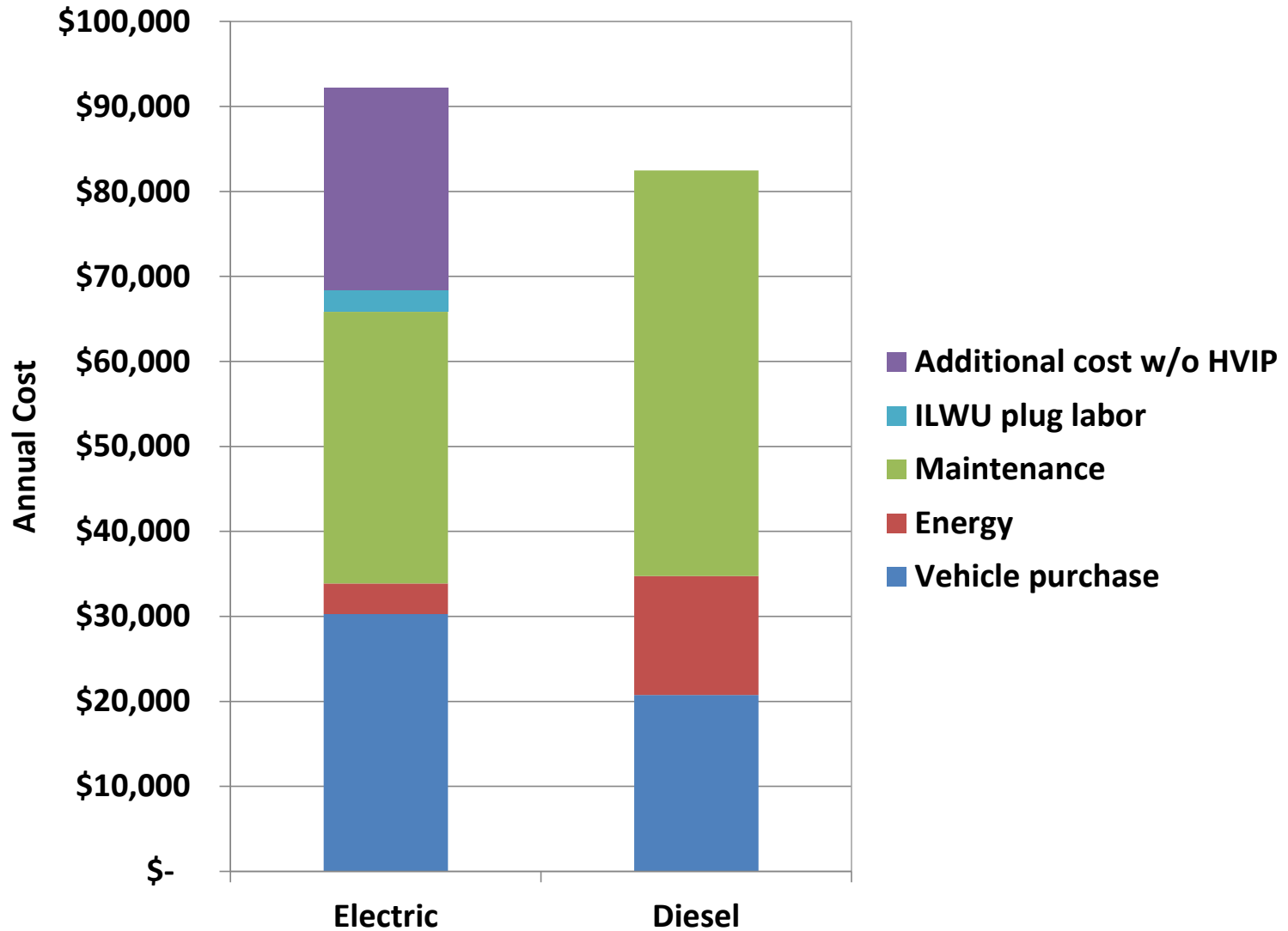
ILWU Work Schedule & Equipment Charging Rhythms



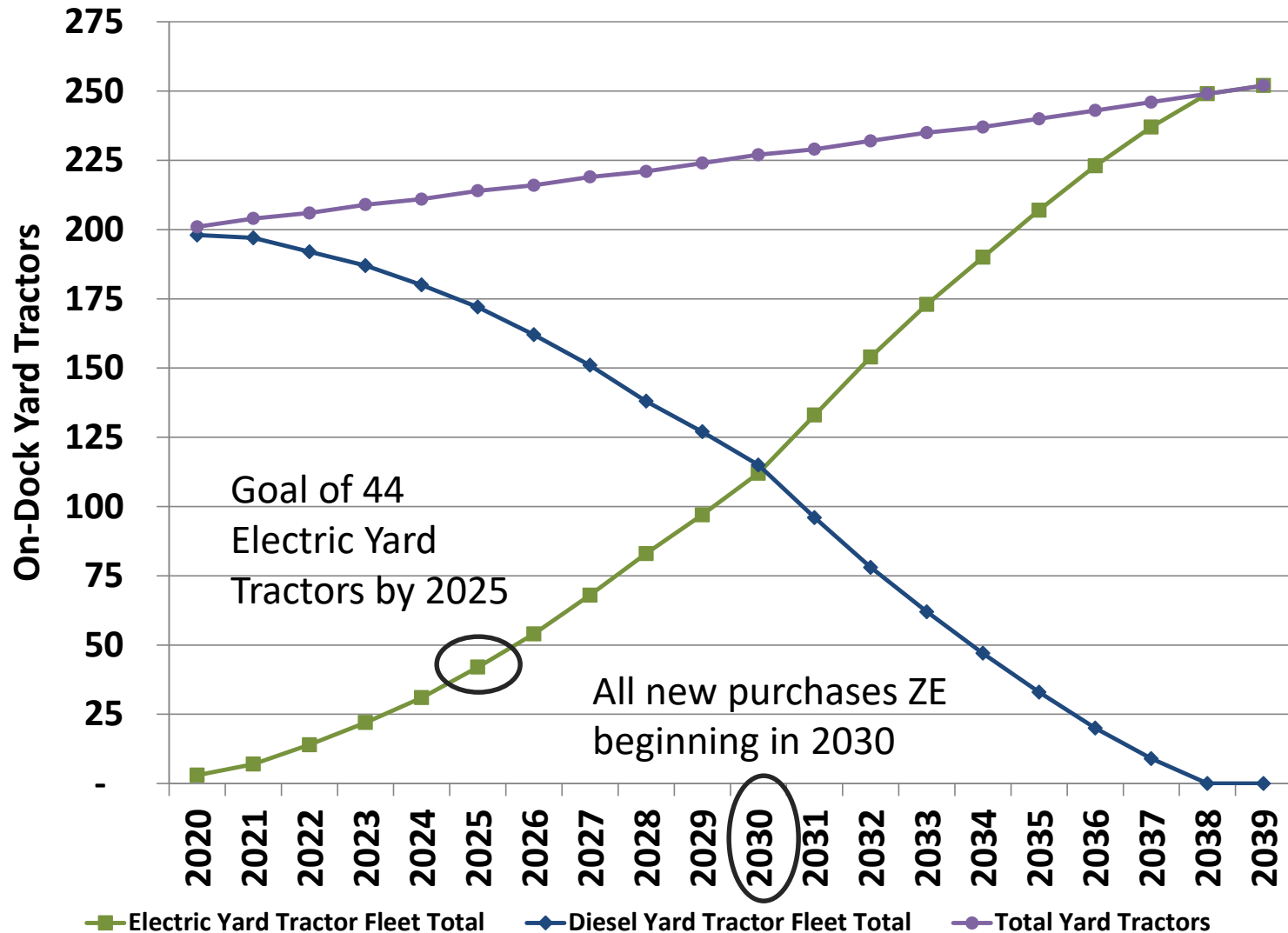
Potential Daily Electric Tractor Charge Rhythms



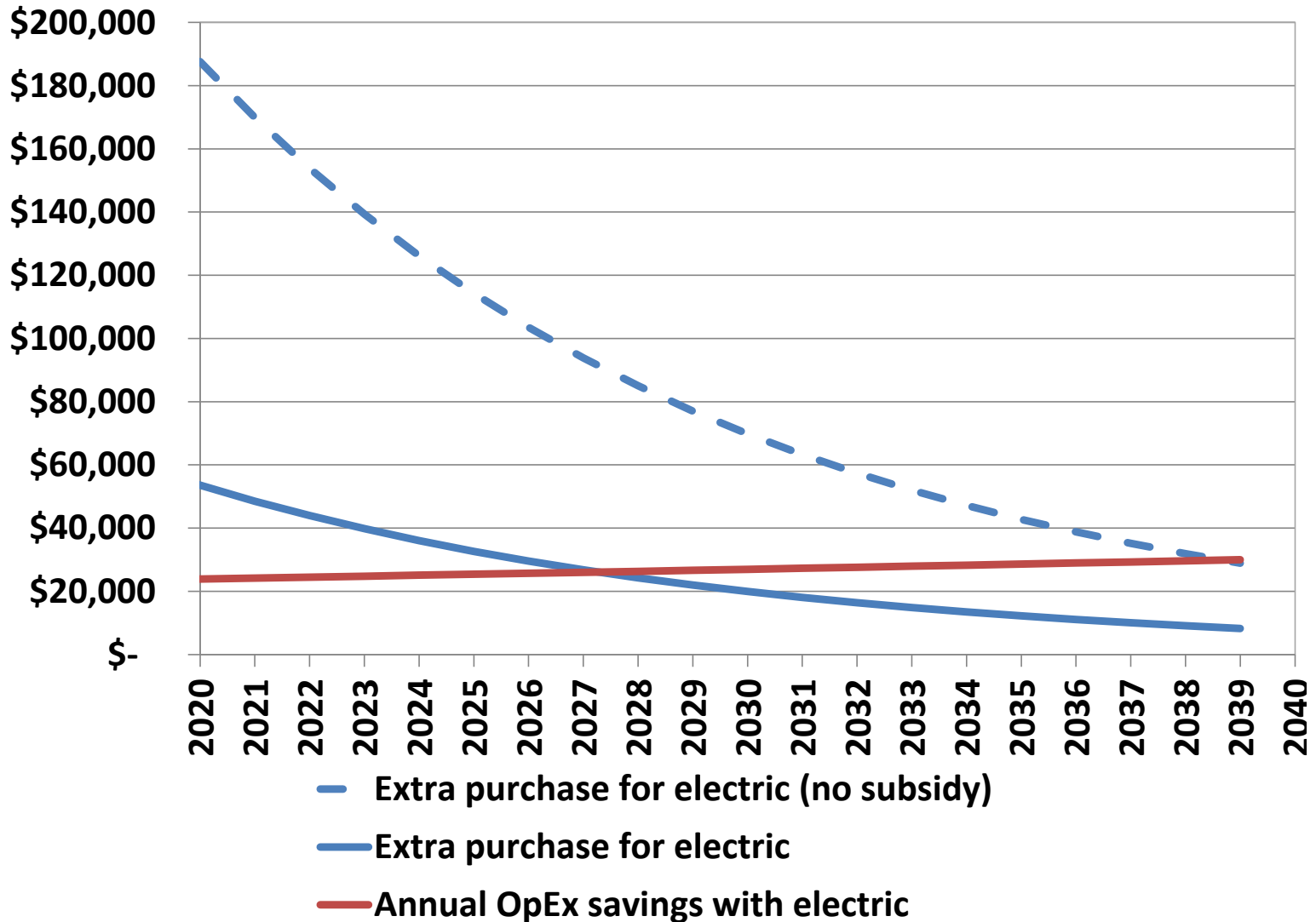
Annual Tractor Cost Comparison (2018)



Gradual Electric Tractor Adoption Chart



Tractor Cost Trend (Equipment Only)



ZE/NZE Drayage Truck Demo Projects at San Pedro Bay Ports

2013				2014				2015				2016				2017				2018				2019				2020				2021							
Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4				
2 ZE Battery Electric (completed)																																							
2 NZE Diesel Hybrid Electric (completed)																																							
1 ZE Battery Electric (completed)																																							
6 ZE Battery Electric with Grid (Catenary) Interface																																							
5 NZE CNG Hybrid Electric with Grid (Catenary) Interface																																							
2 ZE Battery Electric																																							
1 ZE Fuel Cell Electric																																							
37 ZE Battery Electric																																							
4 NZE NG Hybrid Electric																																							
2 NZE Diesel Hybrid Electric																																							
5 ZE Battery Electric w/ Fuel Cell																																							
1 NG Hybrid Electric																																							
2 NZE Diesel Hybrid Electric																																							
5 ZE Battery Electric																																							
2 ZE Battery Electric																																							
1 ZE Battery Electric																																							
3 NZE NG Hybrid Electric																																							
20 NZE NG ICE (12L)																																							
4 NZE NG Hybrid Electric																																							
7 ZE Battery Electric																																							
10 ZE Fuel Cell Electric																																							
8 ZE Battery Electric																																							

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)

Electric Vehicle Readiness

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Hybrid RTGs																		
eRTGs																		
Hybrid side-picks																		
Electric off-dock yard tractors																		
Electric on-dock yard tractors																		
Electric top-picks																		
Low-NO _x CNG trucks																		
Electric short-haul trucks																		
Electric long-haul trucks																		
Hydrogen short-haul trucks																		
Hydrogen long-haul trucks																		
	Early production																	
	Regular production																	



Summary of Findings

- Battery electric is an appealing zero emissions option
 - Electric motors are superior to internal combustion engines
 - True zero emission system when paired with renewable power
 - Leverage existing power grid
- Variety of development states for different types of electric equipment
- Long-term benefits to electrification in terms of OpEx
- Gradual adoption expected
- Overall electric CHE power use will not be large in the short/med term relative to current Port demand, but will grow over time

Conclusions

- Vouchers are vital to making ZEV technology cost-feasible in the near-term
 - Off-road vouchers are expected to become available in Q3 2019
- Hybrids are good intermediate step that require no costly, time-consuming electrical infrastructure installations
- Questions?