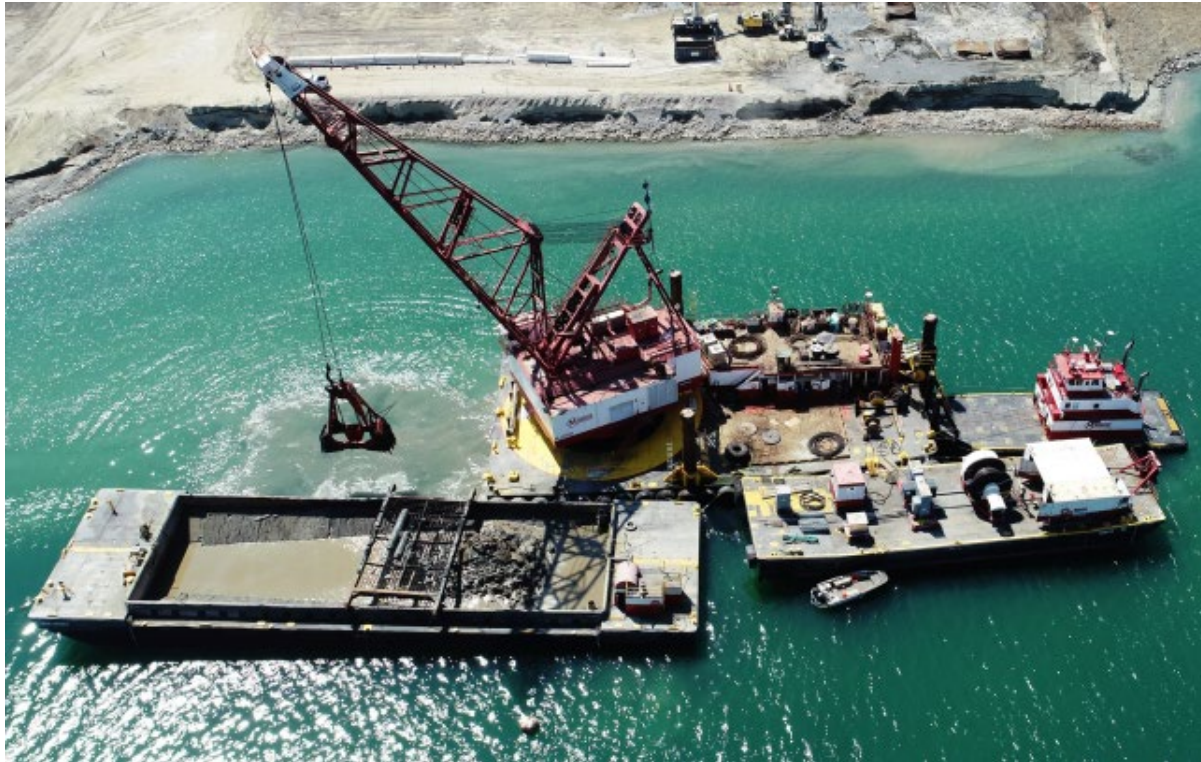


Electric Dredging

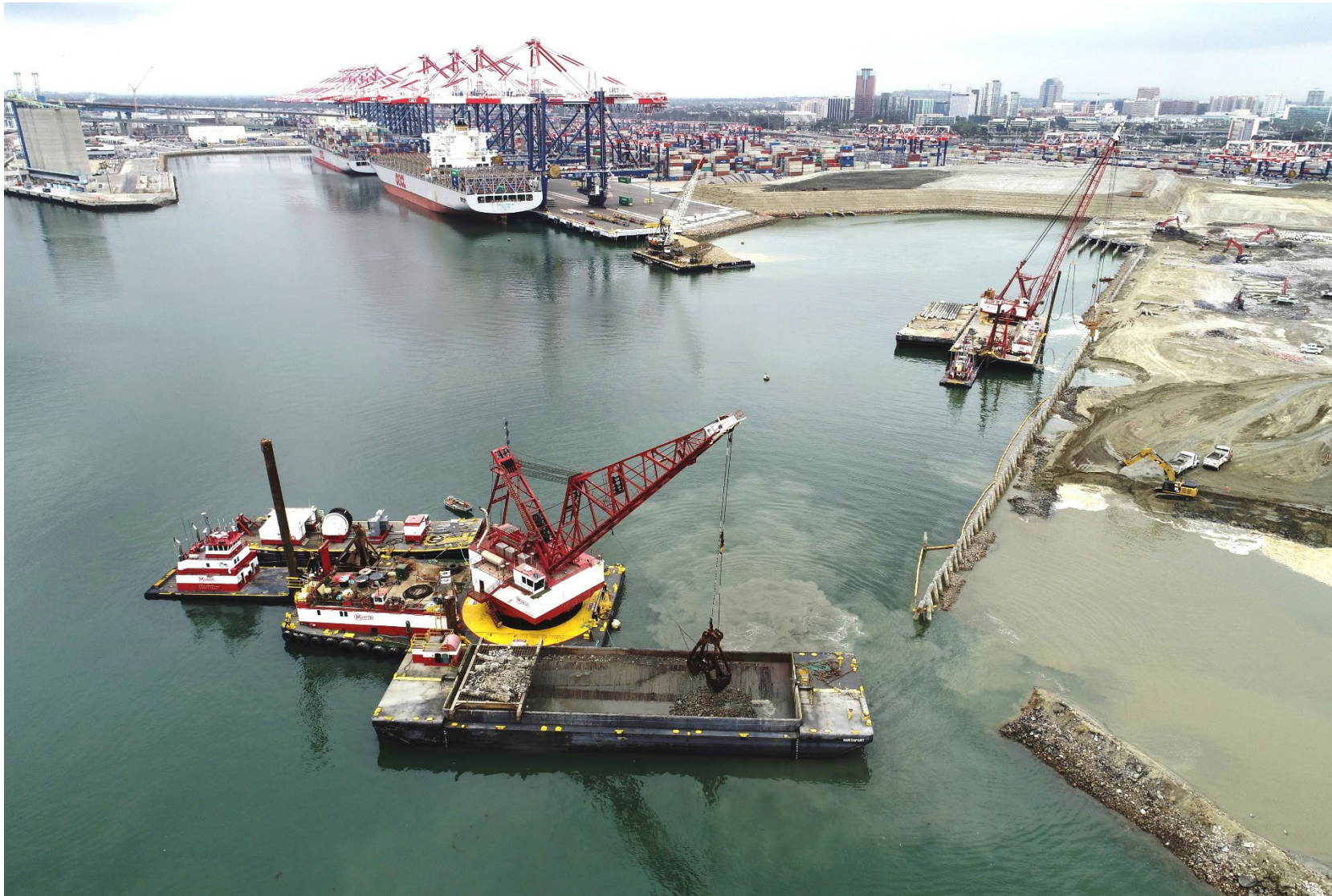


! Manson Dredges with Electric Capability



H.R. Morris

■ Manson Dredges with Electric Capability



DB Njord

! Manson Dredges with Electric Capability



DB Valhalla

! Manson Dredges with Electric Capability



DB Vulcan

■ Manson Dredges with Electric Capability



Reel Barges

! Manson Dredges with Electric Capability



Substations

Current Status of CARB Harbor Craft Regulations

2021 & Earlier	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
IN-USE VESSEL REQUIREMENTS												
Tier 2 or 3 (Tugs, Ferries, Excursion, Crew & Supply, Barge, Dredge)	Any Pre-Tier 1 and 1 → Tier 4*											
	(generally Workboats, Research, Pilot, Tank Barges, and CPFV)											
	≤ MY 1993	MY 1994-2001	MY 2002+									
		Tier 2, 3, 4 → Tier 4*+DPF**										
		Ferries (Except Short Run), Pilot***, All Tugs										
		MY 2007-2009	MY 2010-2012	MY 2013-2015	MY 2016-2019	MY 2020-2021	MY 2022+					
		Tier 2, 3, 4 → Tier 4*+DPF**										
		Research, CPFV, Excursion										
		MY 2007-2010	MY 2011-2012	MY 2013-2014	MY 2015-2017	MY 2018+						
		Tier 2, 3, 4 → Tier 4*+DPF**										
		Dredges, Barges, Crew & Supply, Workboats										
		MY 2007-2009	MY 2010-2013	MY 2014-2017	MY 2018+							
		Any Pre-Tier 1 and 1 → Tier 3 or Cleaner****										
Commercial Fishing												
≤ MY 1987	MY 1988-1997	MY 1998+										
OTHER VESSEL REQUIREMENTS												
Tier 2, 3, or 4 All New Vessels Tier 3 + BACT New Ferries Carrying 75+ Passengers		"New Excursion: Zero-Emission Capable (e.g., Plug-in Hybrid) 30% or more of power must be derived from a zero-emission tailpipe source"										
		New and In-Use Short-Run Ferries: Zero-Emission										

*All engines ≥600 kW would be required to be certified to Tier 4. For engines <600 kW, a Tier 4 certified engine would be required if certified by U.S. EPA or CARB and available by the compliance date.

**Retrofit DPF requirements would apply to all Tier 3 and Tier 4 engines.

***Pilot vessels at Tier 2, 3, or 4 with MY 2007-2009 would not need to comply until December 31st, 2025

****Commercial Fishing Vessels at Tier 2 by January 1, 2023 require no additional compliance under the 2022 Amendments

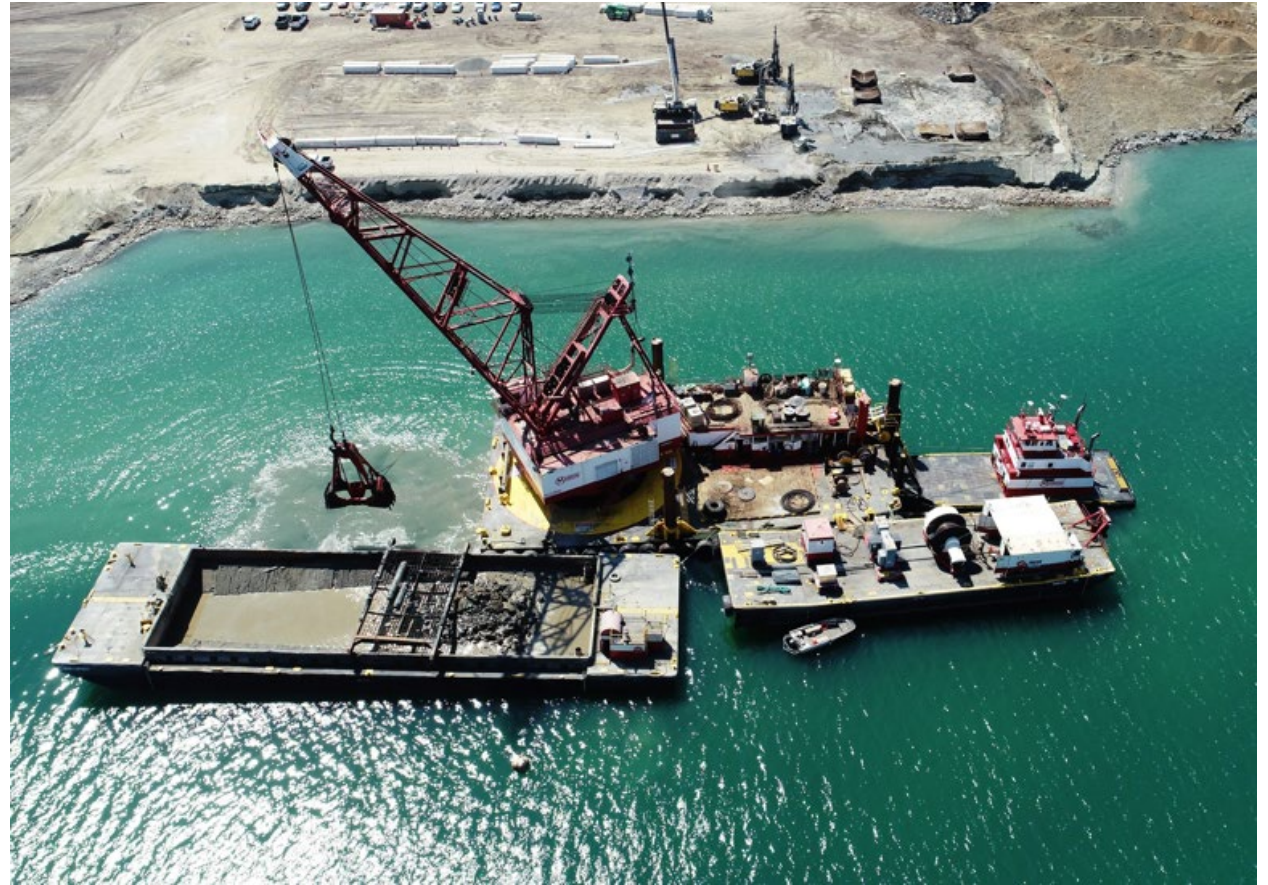
<https://ww2.arb.ca.gov>

This chart describes the compliance year by the engine's model year



| Current Status of CARB Harbor Craft Regulations

- All Dredges operating in California will be required to upgrade to tier 4 engines.
- The requirement date depends on the engine's model year.
- These regulations force in-service change to tiered engines.
- Repowering cannot be avoided; it is a matter of how fast it is required.



- Upgrading to electric circumvents the need for repowering engines

CARB Harbor Craft Regulations vs. PoLB Dredging Requirements

- POLB & POLA New Work Dredging Often Require:
 - Electric Dredges
 - Tier 3 Tugboats
 - In some cases more
- CARB Requires:
 - Compliant with upgrades per the timetable on previous slide.



Cost to Upgrade Dredges to Tier 4

- Procurement and Installation of new engines.
- Lost equipment utilization during repowers.
- Installation often results in significant additional equipment modifications adding cost and time to repowers.
- Tugboats often do not have the space necessary to install Tier 4 after-treatment systems.
- DPF requirement at Tier 4 presents fire risk- CG issue



Cost to add an Electrical Option to a Tier 4 Dredge

- Procure and Fabricate a reel barge, electrical transformation/protection and submarine cable.
- Potentially significant modifications to the dredge to accept electrical power:
 - Structural Modifications
 - Motor upgrades
 - Control System additions/integrations
 - Transition Switches
- As a practical matter, if the dredge is not currently a diesel generator driving electric motors (i.e. diesel electric).. Conversion to fully electric is likely not a practical option.



Tier 4 vs Electric Operating Cost

- Fuel is taken out of the daily cost. This cost of power is typically substantially lower than fuel bill.
- Additional Operating Costs for the reel barge include:
 - Equipment Rent/Operations of reel barge
 - Potentially Additional Labor
 - Slower move times.
- Proximity to the Substation can affect cost. Further Away = More Risk and More Expense.
- Costs associated with building, upgrading, or modifying a substation.
- Additional time and equipment to initially plug in a move to dredging location.
- Risk/Downtime associated with faults in the electrical systems or damage to the power cable.



Hopper Dredges

- Currently there are no Electric Trailing Suction Hopper Dredges in the US Market.
- Several Hopper Dredges are Diesel Electric (Including the nation's largest Frederick Paup). However, a power cable is not an option.
- Battery power at hopper dredge power level (20MW) is impractical currently.

