



California Hydrogen Business Council
Hydrogen and Fuel Cells in Ports and Shipping Workshop
October 9-10, 2018
Los Angeles, CA

Water-Go-Round

Dr. Joseph Pratt, CEO & CTO
GOLDEN GATE **ZERO** EMISSION MARINE

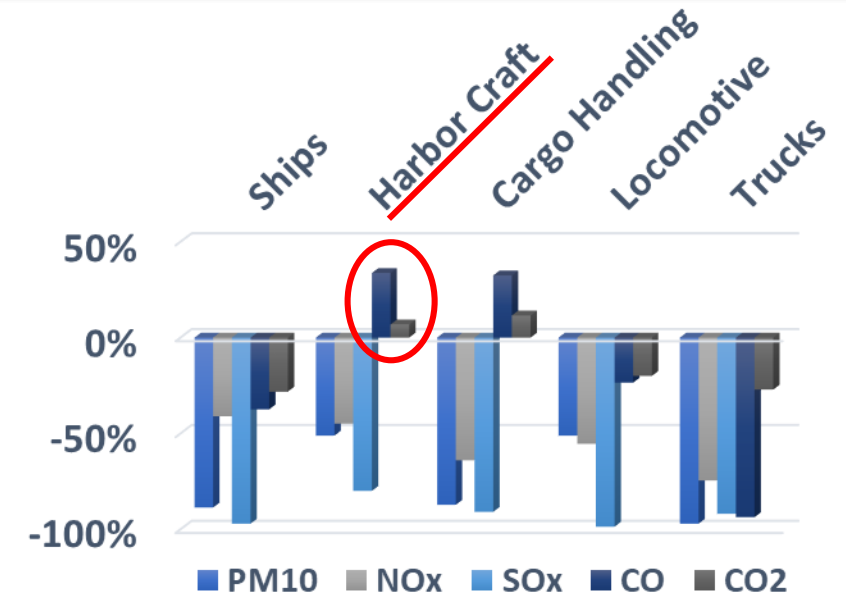
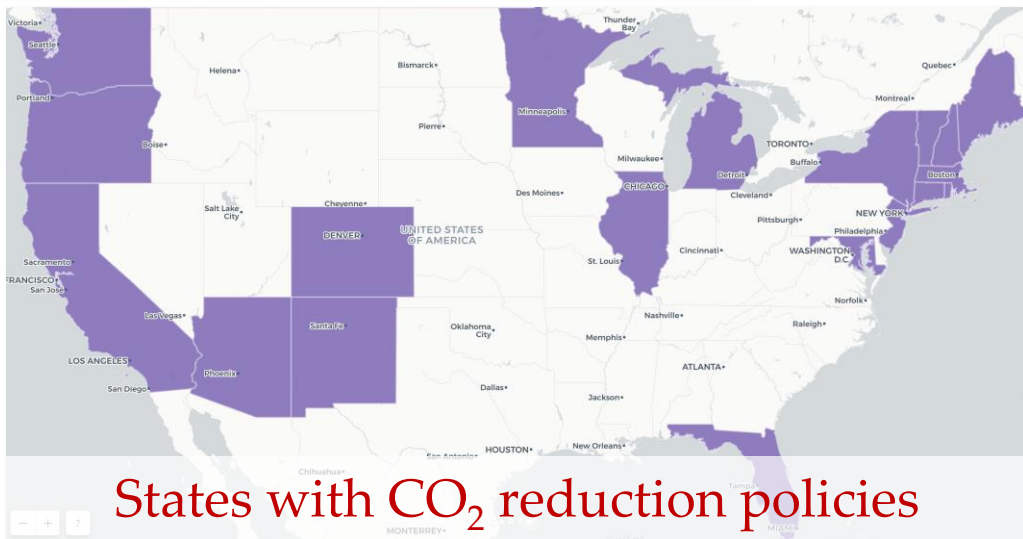


From international to local levels, environmental regulations are growing stronger, not going away.

Report: 28 of 100 World's Largest Ports Offer Incentives for Green Ships

IMO adopts plan for 50% cuts to shipping GHG emissions by 2050

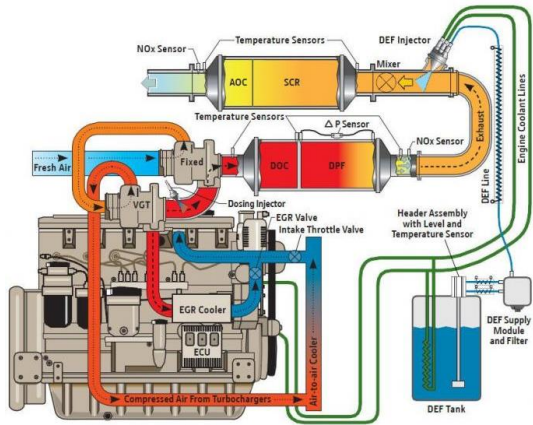
Norway Mandates World's First Zero-Emission ECA for No Later Than 2026



Emission changes at the Port of Long Beach, 2005-2016

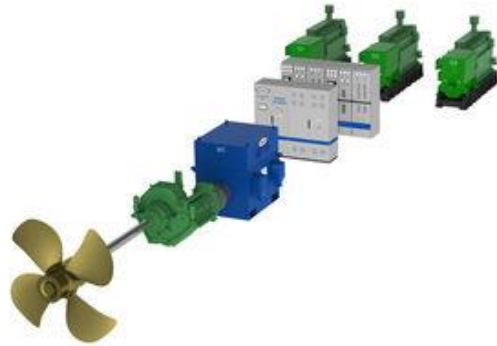
Emission Reduction Options

Tier 4 Diesel



NOx: Low
SOx: Low
CO₂: no change

Electric Hybrid



NOx: Low
SOx: Low
CO₂: 10%-40% lower

LNG



NOx: Low
SOx: 0
CO₂: +/- 10%

All-electric Battery or Hydrogen Fuel Cell



NOx: 0
SOx: 0
CO₂: 0

Now

Next

Bridge

Final

Batteries and fuel cells offer complimentary solutions, enabling all kinds of vessels to run with zero emissions

Best Application Space



Higher Power

Lower Power



Battery

Fuel Cell

Either

Fuel Cell



Shorter Range



Longer Range

Technology Comparison

Diesel and LNG

- ✓ Flexible
- ✗ Zero Emission
- ✗ Simple Maintenance

Battery Electric

- ✗ Flexible
- ✓ Zero Emission
- ✓ Simple Maintenance



Fuel Cell *Best of Both*

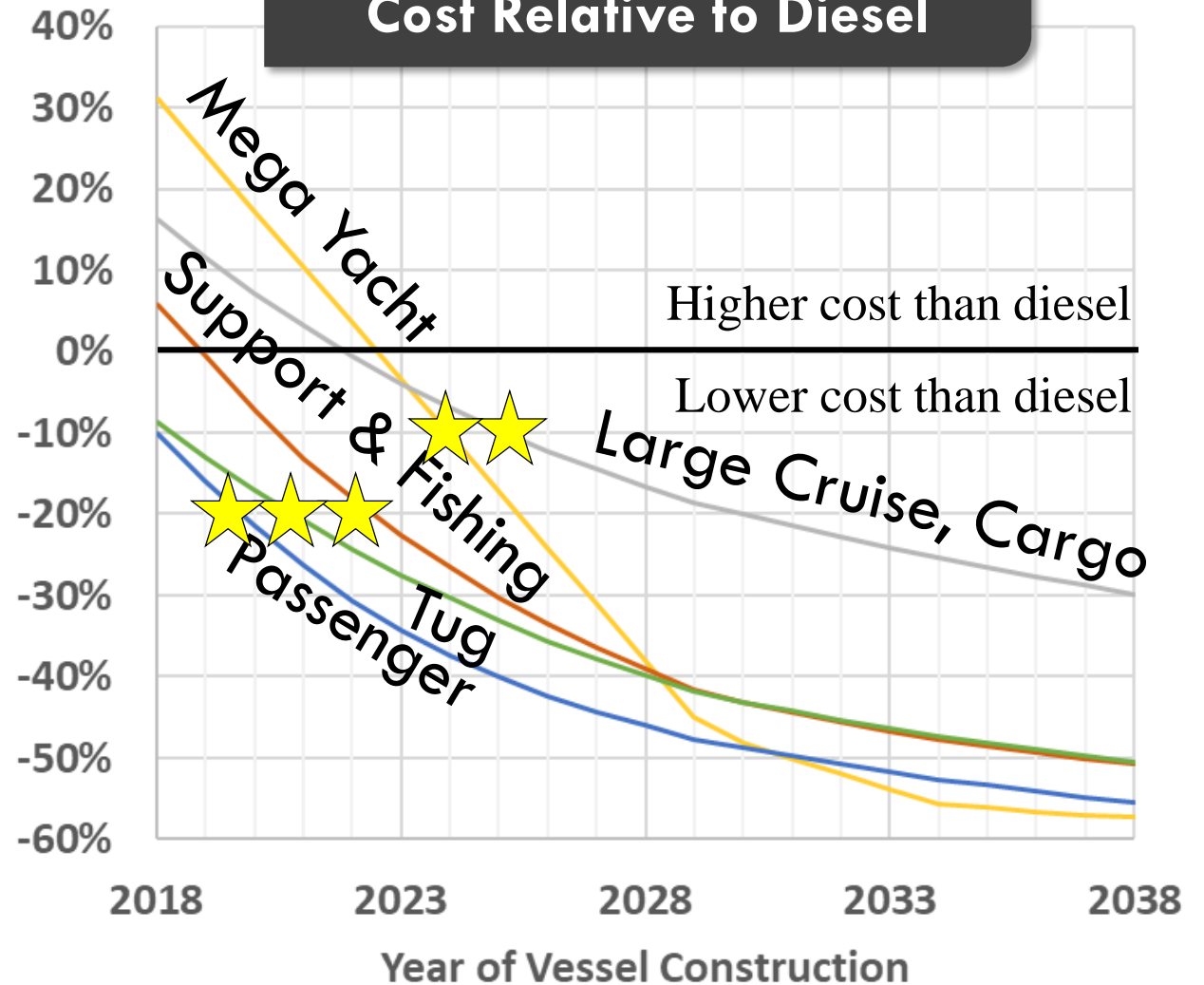
- ✓ Flexible
- ✓ Zero Emission
- ✓ Simple Maintenance

GGZEM's systems have a lower lifetime operating cost than diesel.

Reasons:

- Dropping fuel cell costs
- Dropping hydrogen costs
- Stack lifetime increases
- Less, easier maintenance

GGZEM System's Operating Cost Relative to Diesel



The Water-Go-Round



- Aluminum catamaran
- 70' / 21 m LOA
- 84 passenger (reconfigurable)
- 22 knot top speed
- 2x 300 kW electric motors
- 360 kW PEM fuel cell
- 100 kWh Li-ion battery
- H₂: 264 kg @ 250 bar

Key Milestones

Project Began	June 11, 2018
Ferry Design Complete	Oct. 2018
Ferry Build Begins	Nov. 2018
Keel Laying Ceremony	Nov. 8, 2018
Powertrain System Installed	March 2019
First launch/christening	Sept. 1, 2019
Ferry In Service	Oct. 1, 2019
Three Months Data Collection Finished	Dec. 31, 2019
Draft Final Report to CARB Due	Feb. 14, 2020
Project Ends	March 30, 2020

Water-Go-Round Project Partners

Project Lead



GOLDEN GATE
ZERO
EMISSION MARINE

Funding & Administration



This project is supported by the "California Climate Investments" (CCI) program

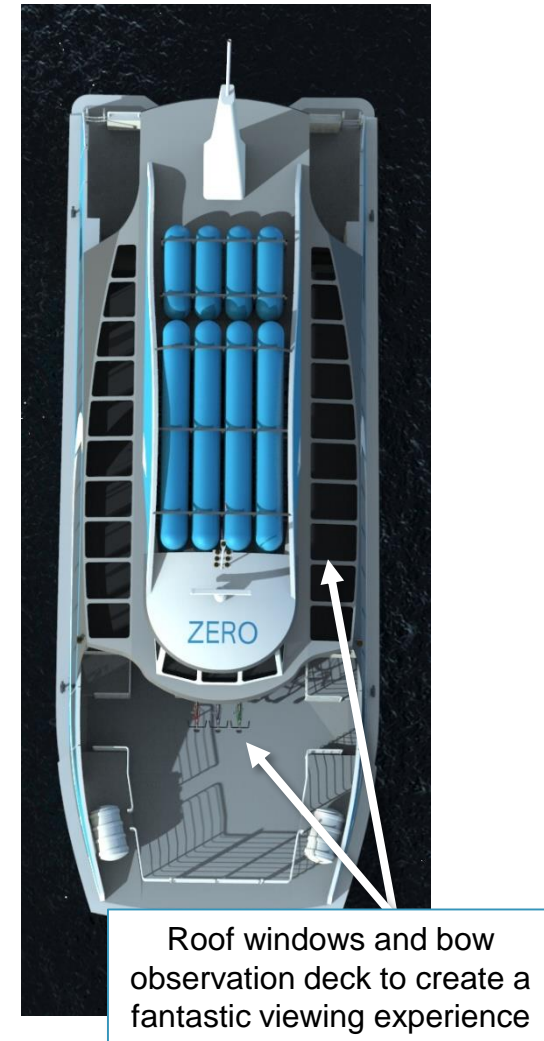
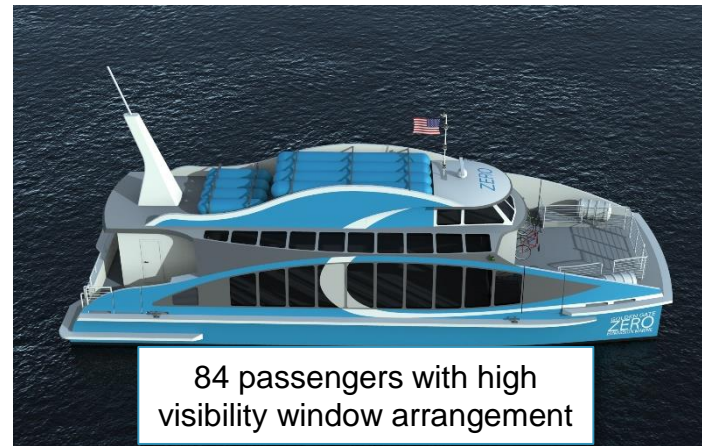
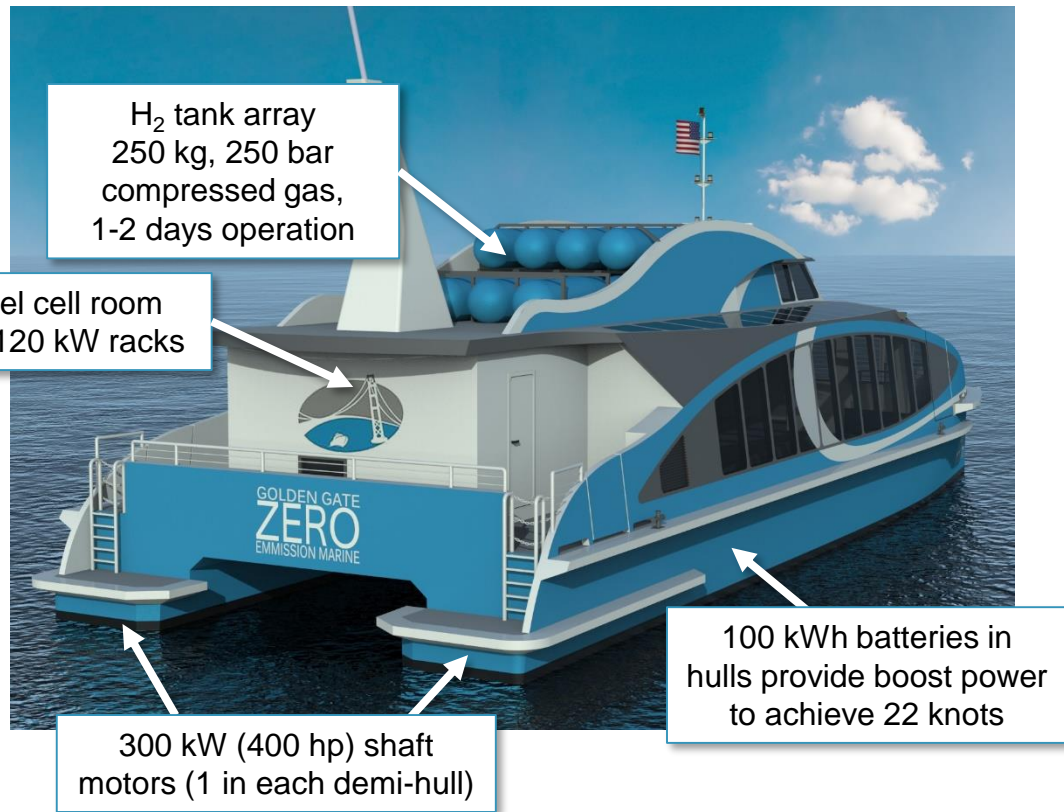
Cost-Sharing Partners

BAE SYSTEMS

HYDROGENICS



Water-Go-Round Features



The fueling will look like today's operation with diesel



The US Coast Guard will review and approve all of the fueling and safety procedures

California's Office of Spill Prevention and Response (OSPR) has exempted hydrogen fueling from the insurance requirements imposed on diesel fueling

Usage: The WGR will be on the water in Fall 2019 and will operate for at least 3 months in trials for CARB



Planned uses during the trial:

- Commuter ferry
- Excursion/tour boat
- Research/survey vessel
- Package/freight delivery
- Crew boat

Thank You!

GOLDEN GATE **ZERO** EMISSION MARINE offers modular zero emission fuel cell powertrains for New Builds and Repowers for:

- Tugs
- Ferry boats
- Sightseeing and Excursion boats
- Offshore Supply
- Cargo

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