

Clean Marine Transit Overview



MARAD Workshop

*November 2, 2000
Alameda, CA*

John Boesel
President
www.calstart.org

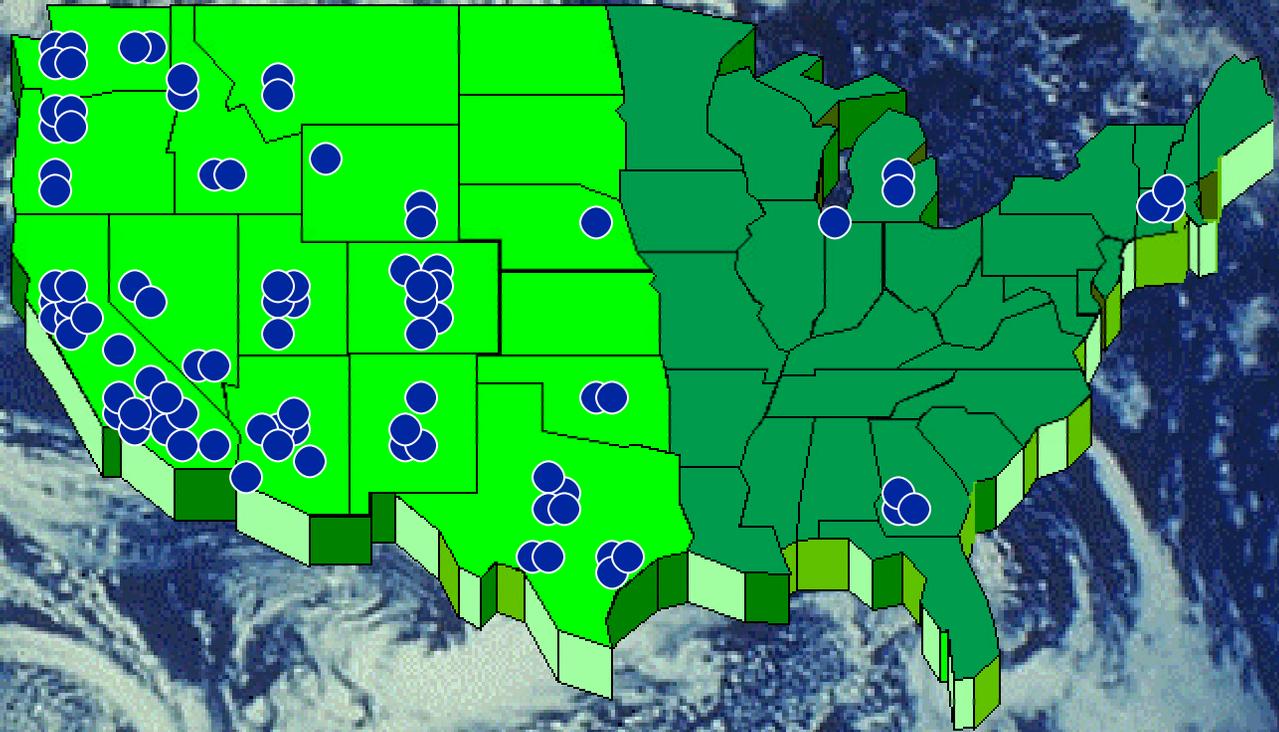
WestStart Consortium: A “Virtual” Business Cluster



2000

**150+ Worldwide
Participant
Network**

**6 Offices in 4
Western States**





WestStart Participants

- **Motorola**
- Toyota Motor Corporation
- General Motors Advanced Technology Vehicles
- Daimler Chrysler
- Motor Coach Industries
- Freightliner Corporation
- **Lockheed Martin**
- **Gas Technology Institute**
- However, 70% Are Small Start-up Businesses

Yellow font indicates Boardmembers



What WestStart Does

Spurring technology - manage technology development and demonstration projects

Implementation for fleets - clean solutions for airports, parks, and campuses

Industry information and analysis - provide industry information services, market research, marketing, reports and studies

Mobility Systems - developing and implementing clean mobility systems





New Technology Threat to OPEC - Saudi Sheik

- Technology will reduce consumption, increase production from areas outside OPEC
- Within 20 years technology will have cut deep into demand for transport fuels
- Hybrid engines and hydrogen fuel cells will drastically cut consumption of gasoline

“Technology is the the real enemy for OPEC”

***--Shiek Ahmed
Zaki Yamani,
former Saudi
Arabian Oil Minister***



Air Pollution Health Effects

- **USC Study Shows NO_x and PM dangerous to children (*USC Study*)**
- **L.A. air contains 426-times allowable level of air toxics (*House report*)**





EPA Calls for Lower Sulfur Fuel



United States
Environmental Protection Agency

"...to protect human health and to safeguard the natural environment..."

- May, 2000 EPA proposes rules to cut truck and bus emissions by a 97% reduction in sulfur content in diesel fuel over next 10 years
- EPA officials claim it's the biggest effort to reduce smog and cut toxic air contaminants in the agency's 30 year history
- Rules calls for 95% reduction in NOx and 90% reduction in PM
- Move comparable to removing lead from gasoline

TOSCO to Supply Low Sulphur Diesel to NY MTA



- Tosco will supply low sulfur diesel fuel to NY MTA for use in diesel-powered buses
- Maximum sulfur content of fuel not to exceed 30 ppm - 90% lower than current EPA maximum of 500 ppm
- Deliveries started in Sept. 2000
- First large city transit agency to convert its bus fleet to ultra low sulfur diesel fuel



EPA Sets Rules for Cleaner Diesel Engines



United States
Environmental Protection Agency

"...to protect human health and to safeguard the natural environment..."

- August, 2000 EPA adopts rule requiring cleaner diesel engines for truck and bus
- Engines must emit 40% less air pollution by 2004
- Rule is part of EPA's two-part strategy to improve vehicle engines and have cleaner diesel fuel in U.S. market
- Second phase of program will require cleaner diesel fuel with lower sulphur content and cleaner engines by 2007, reducing bus and truck pollution by another 90%.

U.S. Forest Service and Park Service Banning Off-Road Vehicles?



Recreation is soaring in national forests and parks

Off-road vehicles major sources of pollution

Bans proposed on snowmobiles in select parks

Environmentalists pushing to ban all off-road vehicles at parks and forests



NGV Market Niches



- High mileage fleets needed to pay for station costs
- Cost cheaper than gasoline at current prices
- M-HDV Markets: buses, refuse trucks, and intra-regional trucking
- LDV Markets: shared ride, police, taxi, and government fleets



Natural Gas Transit Buses

- 22% of all new transit buses are fueled by natural gas
- Major transit properties making switch to NG
- 3,204 NG Transit Buses on Road Today
- 70-80% CNG



LAMTA Purchases Another 370 CNG Buses



- Passengers union demanded NG purchase
- By Q1 2001, MTA will have more than 1,500 CNG Buses
- LAMTA now largest operator of CNG buses in World
- SCAQMD study attributes 70% of toxic air emissions to diesel trucks and buses
- NGVs represent 1 day of throughput for SoCal Gas -- Utility

Washington D.C. Transit Plans CNG Buses



- Washington Metropolitan Transit District announced plans in Sept 2000 to purchase 100 CNG buses at a cost of \$39 million
- D.C. mayor calls for CNG only bus purchases and expanded clean fuels in existing diesel buses
- New buses could be put into operation by November 2001



India's Supreme Court Mandates CNG Buses



New Delhi

- India Supreme Court mandate requires entire New Delhi bus fleet to convert to natural gas or remove buses from service
- Involves 7,000 transit buses and 2,000 school buses
- Currently 42 CNG buses using Cummins engines are in operation with 1,000 on order
- National utility will install 80 public CNG refueling stations



Deere Pushing NG Bus and Truck Market

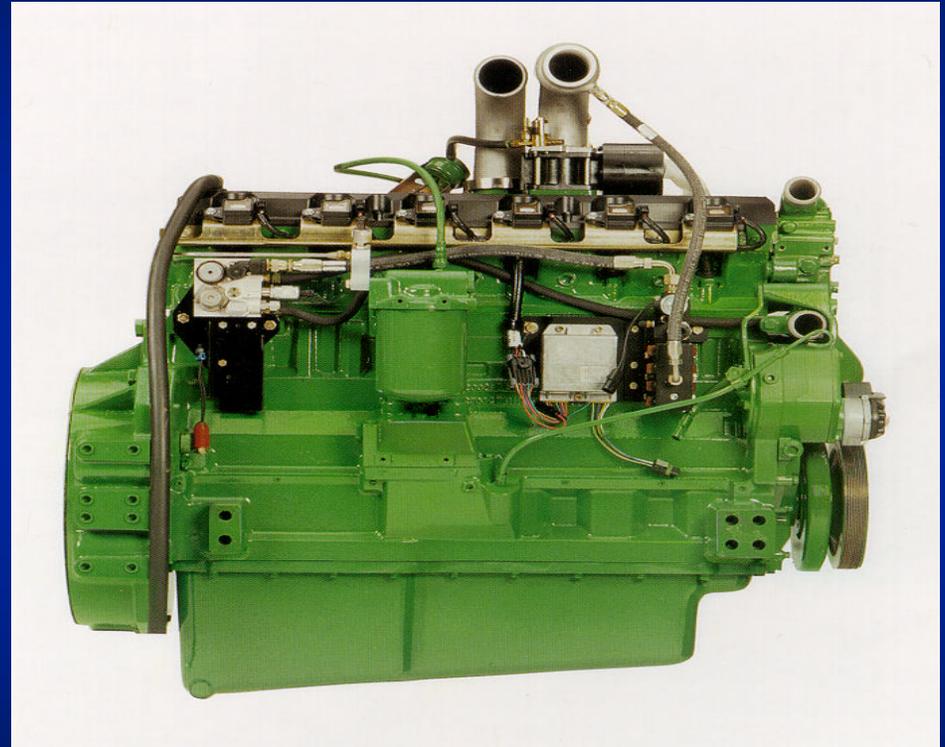


Optimized spark ignited engine -- lean burn, closed-loop, adaptive learn

Diesel performance for Power and Torque

Fuel economy on par with diesel

Partnership with Bluebird



DEERE
POWER

Westport Direct Injection NG Bus



High-pressure, direct-injection natural gas technology

Far lower emissions than diesel but maintains diesel performance and efficiency

Formed strategic alliance with Cummins





Freightliner/Power Systems Dual-Fuel Class 8:



- Combination LNG-diesel, 85%-15% engine
- 400-mile range
- 119 gallons onboard with tanks in frame rails
- 410 BHP, 1,250 lb. ft. torque
- 80,000 lb. Capacity
- Caterpillar system built by Power Systems

Clean Ports: LNG Use Study



Determined the feasibility of port trucking and other fleets to use liquefied natural gas (LNG)

Identified barriers and implementation strategies

Ports reviewed - Los Angeles and Oakland

Funded by DOE; Ports of L.A. & Oakland; Pacific Gas & Electric; and So. Cal. Gas





S.F. Bay Ferry System Expansion Questioned



- Blue Ribbon Commission Calls for \$2 Billion -- 120 Ferry System
- Environmental groups question benefits
- CALSTART will conduct comparative door-to-door analysis
- Funded by DOE (BNL), DOT, and GTI

Clean Marine Opportunities Partnership



- Focused on developing cleanest possible marine transit system
- Partners include: Bay Area Council, Carnegie Mellon University, Gas Technology Institute, GANA Inc., and CALSTART
- Seeking funding for NG Ferry demonstration
- Incorporate programs real-time emissions monitoring

Proposed LNG Tug Demonstration



- 50 Tugs Currently in Operation in Ports of LA and Long Beach
- Tugs Operate on Relatively Fixed Duty Cycle -- Analogous to Transit Buses
- Estimated 70% Reduction in NOx and 50% Decrease in PM with Natural Gas

National Park Clean Ferry Analysis



- National Park Seeks to Provide Ferry Service to New Parks in SF Bay Area
- Analyzed Potential for NG As Fuel for Expanded Ferry Service
- Emissions benefits significant



New York Orders Hybrid Buses

- 125 hybrid buses ordered
- HybriDrive propulsion system from Lockheed Martin
- Uses AC-drive system powered by diesel generator and batteries
- More fuel efficient with far less emissions
- Bids for 175 submitted

**HybriDrive propulsion system
achieved 80,000+ miles of daily
revenue bus service in 1999**

Hybrid Electric Ferries?



- Technology becoming well established in light and heavy-duty applications
- Key advantage is fuel economy in urban setting
- Take advantage of regenerative braking
- Additional study required



Fuel Cells Riding High on Energy Crisis of 2000



- Stocks of 40+ public fuel cell companies have shown gain of 400 percent, raised \$1.9 billion in capital in 2000
- Big gainers - Ballard, H Power, Millennium Cell, Plug Power, DCH Technology, Hydrogenics
- Analysts concern of overvaluation; see long time for commercialization because of costs, safe storage and transport
- Viewed as back-up power for now



Ford-DaimlerChrysler: Setting the Perception Pace



Necar 4 fuel cell



P-2000 fuel cell

Daimler Benz: 1997 Prediction on Fuel Cell Vehicles



- Daimler Benz Boldly predicted in September 1997 that sales of hybrid-electric fuel-cell cars will hit 100,000 by the year 2010 and that it will capture "well over 50 percent of the fuel-cell vehicle market."
Some say 40,000 light-duty vehicles by 2010 from all manufacturers may be optimistic
- *Cost and infrastructure challenges remain significant*

"We don't really see fuel cell vehicles making significant inroads into the market for 10 years, and it may take 20 years."

-- Tomohiko Kawanabe, Director of Honda's Tochigi Research and Development Centre -- September, 2000





Iceland Hydrogen Project Europe

- DaimlerChrysler, Royal Dutch/Shell, Norsk Hydro, EcoEnergy partners
- Propose fueling cars, trucks, buses -- even fishing boats -- with hydrogen
- Bus will roll out first
- Perfect “closed system” for testing hydrogen concept





ZeTek Power Fuel Cell Boat



- Hydra -- first fuel cell boat licensed for passenger traffic
- Uses alkaline fuel cell
- Deployed in Bonn, Germany
- 12 meters with maximum speed of 6 knots

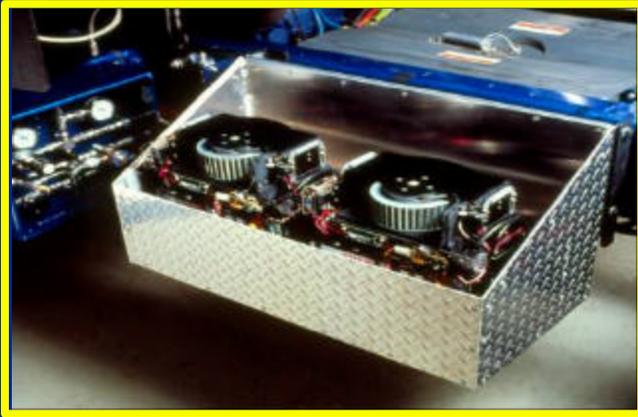
HARC Fuel Cells Test in Cruise Ships



- Houston Advanced Research Center to test at Port of Houston
- 250 kWh fuel cell unit to be installed adjacent to where cruise ship docks to supply electricity; reduce load of on-board generators
- Use expected to cut emissions and fuel usage



Fuel Cell Auxiliary Power Unit



Team: Freightliner, XCELLSIS
and DaimlerChrysler

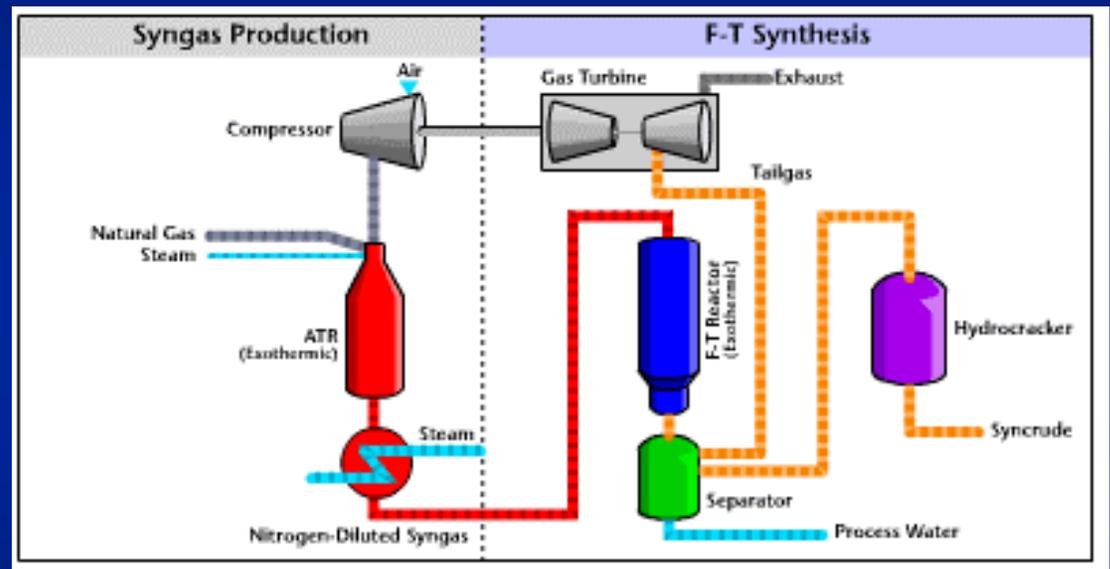
- Fuel cell power for truck accessories during non-driving operations
- Reduces emissions and increases engine life
- 5-10 kW of power





Syntroleum Fuel -- Cuts Diesel Emissions 88%?

- Southwest Research testing shows synthetic diesel fuel cuts diesel car emissions 88%; pickup emissions 40%; heavy-duty engine roughly 40%
- Fuel can also be used for fuel cell feed-stock



Syntroleum

Biodiesel Boat - Channel Islands National Park



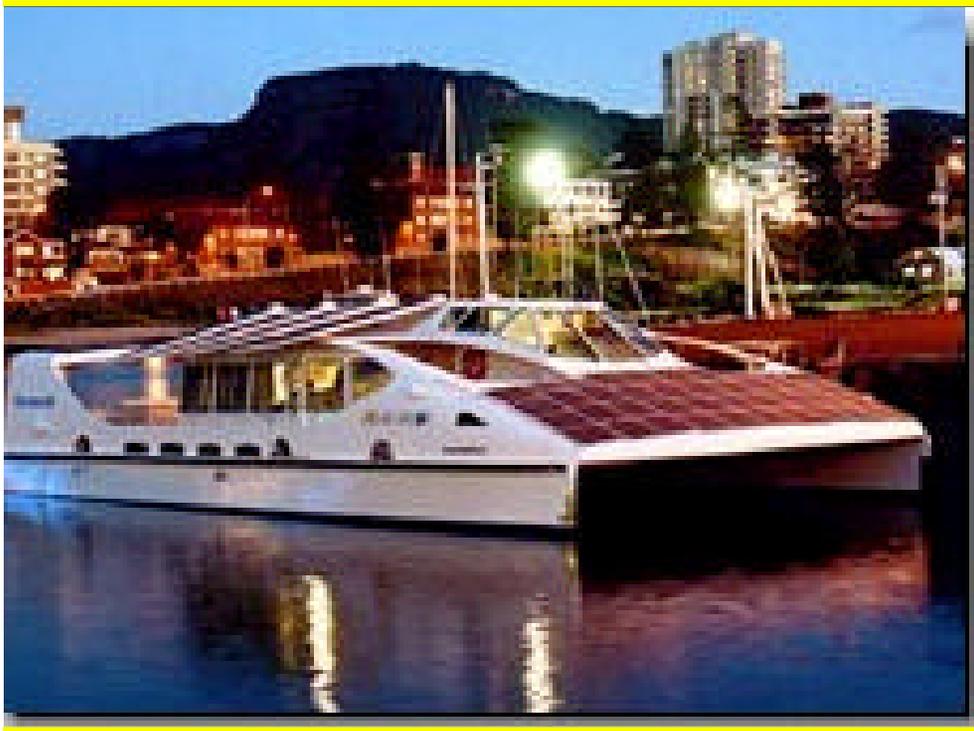
Pacific Ranger



- “Pacific Ranger” park vessel servicing NPS marine research platform off Ventura County coast
- Two year demonstration project using 100% biodiesel fuel from cooking oil
- 24 passenger capacity
- 56 feet long



Solar Sailor



Australia Passenger Ferry

- Largest solar vessel -- up to 100 passengers
- Solar panels raised and used as sails
- Practical for short routes
- 2 40-kW permanent magnet brushless DC motors
- 5 - 7 knots on solar power alone
- Back-up LPG gas generator and batteries

For the Riders or the Contributors?



- Why should a commuter ferry operator consider alternative fuels?
- Santa Barbara MTD has largest electric bus fleet in country. SunLine Transit has 100% CNG bus fleet.
- 5-10% of residents actually ride the buses
- 70-80% have favorable impression of the buses and the transit property
- **Everyone pays**



Portfolio Diversification

- Are all your investments in stocks?
- Energy diversity = greater economic security
- Diversified fuel supplies can lead to competitive advantages
- Should national, state, or regional economies be dependent upon OPEC's decisions?



Future Work

- **Public health benefits of clean marine technology significant**
- **Renewed need for energy independence**
- **Rapid pace of clean marine technology likely to mirror pace of on-road vehicle technology**
- **Additional development and demonstrations needed**
- **Appropriate role for federal research, development, and demonstration funding**



Clean Transportation Solutions SM

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