Connecticut Power & Energy Society





Fuel Cells for Public Transportation in CT

- Economic and other Benefits
- State of the Technology
- Business Outlook

Subject to the EAR, <u>ECCN EAR99</u>. This information is subject to the export control laws of the United States, specifically including the Export Administration Regulations (EAR), 15 C.F.R. Part 730 et seq. Transfer, retransfer, or disclosure of this data by any means to a non-U.S. person (individual or company), whether in the United States or abroad, without any required export license or other approval from the U.S. Government is prohibited.



Economic & Other Benefits



Fuel Cell Efficiency:

- ~2X better than Diesel,
- ~ 2.7X better then CNG



Emissions & Health:

Fuel Cell Bus: Water vapor exhaust Diesel Bus: The EPA classifies diesel exhaust as "likely to be carcinogenic to humans."

Energy Security

<u>Flexible Sources</u>: Natural gas, coal & oil based electrical

Energy storage for solar, wind, geothermal

ENERGY REINVENTED



Fuel Cell Technology- Design & MFG







Cost: 25-50% lower in moderate volumes Size: 1/3 the size of previous model Manufacturing: Pre-production design



Next Gen Fuel Cell Bus

- US Manufactured & Serviced
- Lightweight body
- Electric Drive & Accessories
- ~300 mile range

ENERGY REINVENTED



Productive. Secure. Clean.

Fuel Cell Technology- Durability



FC Durability- Significant Progress



Current durability forecast: Fuel cell powerplants will meet or exceed diesel bus engines within 2-3 years

ENERG	Y REINV	/ENTED
--------------	----------------	---------------



Productive. Secure. Clean.



Key enablers for fuel cell buses:

- Larger bus deployments
 - Fuel cell buses are costly due to very low volumes of key components
 - US bus OEM's production methods are for larger orders
- Federal or local incentives for the initial higher capital cost of FC buses
- Low cost and available H2 Infrastructure

Active sponsors of fuel cells for transportation: USA: Connecticut, California, Michigan, Ohio, Hawaii Worldwide: EU, Japan, Korea





Thank You!

ENERGY REINVENTED

6 Subject to Export Control Regulations See Slide 1 for Details



Productive. Secure. Clean.











Greater New Haven Clean Cities Coalition, Inc.







US Dept. of Energy Clean Cities Date: November 14, 2012 Program

Presenter Lee Grannis

Title: CPES Dinner-Transportation Ttechnologies Location: Cromwell Merriott E-mail: Lgrannis@snet.net







Clean Cities Mission

To advance the energy, economic, and environmental security of the U.S. by supporting local decisions to reduce petroleum use in transportation.

- Energy Policy Act of 1992 (EPAct)
- Provides a framework for businesses and government agencies to work together
- Goal: Reduce U.S. petroleum use by 2.5 billion gallons per year

Clean Cities Coalitions



- Nearly 87 coalitions in 45 states
- 775,000 AFVs using alternative fuels
- 6,600 fueling stations



Clean Cities Coalitions

Clean Cities Stakeholders



Coalitions are made up of local and national stakeholders.

- 8,400 stakeholders nationwide
- 49% private-sector stakeholders
- 51% public-sector stakeholders













EXCEPTIONAL ENERGY®







Clean Cities Strategies



- Replace petroleum with alternative and renewable fuels
- Reduce petroleum use through fuel efficiency measures, smarter driving practices, and idle reduction
- Eliminate petroleum use by promoting mass transit, trip elimination, and congestion mitigation

Clean Cities has saved nearly 3 billion gallons of petroleum since 1993.



Eliminate

Clean Cities Portfolio of Technologies



Alternative and Renewable Fuels

- Biodiesel
- Electricity
- Ethanol (E85)
- Hydrogen
- Natural gas
- Propane

Fuel Economy

- Fuel efficient vehicles
- Driving habits
- Vehicle maintenance

Idle Reduction

- Technologies
- Behavioral changes

Trip Elimination

- Telecommuting
- Ridesharing



Clean Cities / 12

Clean Cities Strengthens Markets

- Connecting fleets with fuel providers and industry partners
- Training and information
- Technical assistance
- Funding
- Education and outreach to decision makers, fleets, and the public





Alternative Fuels & Advanced Vehicles Data Center





FuelEconomy.gov





Online Information Resources



Clean Cities <u>www.cleancities.energy.gov</u>

Alternative Fuels & Advanced Vehicles Data Center <u>www.afdc.energy.gov</u>

FuelEconomy.gov www.fueleconomy.gov

Clean Cities Coordinators and Coalitions <u>www.afdc.energy.gov/cleancities/coalitions/coalition_locations.php</u>





The Greater New Haven Clean Cities Coalition, Inc.

- Designated October 1995
- Non-Profit Under Transportation Energy Partnership (TEP)
- More than 40 Stakeholders
- Initially only included the City of New Haven, expanded in late 1990 to include all of New Haven County
- Started Coalition and took over as coordinator in 1997
- Registered as a Authorized Recipient of USDOE and other Federal Funds
- Fuel Neutral





New Haven Public Works Compressed Natural Gas Filling Station

- CNG Station at New Haven Public Works Opened 2000
- Used CNG Station from Gas Utility
- Funding from Unused Grant Funds
- Date: Initiated in 1990 with \$50,000 Federal Funding









Ford Electric Ranger Pickup

- 4 Ford (Lead Acid) Electric Ranger Pickups for City of New Haven Use
- Connecticut DOT Alternative Fuel Program
- Funding Source FHWA CMAQ Funds \$14,000 Federal Funding for Leasing
- In Service Feb 2002 3-year Program with Data Reporting Requirement
- Vehicles were leased from Ford and Used by New Haven Departments
- Short Range and Vehicle Poor Mean Time Between Failure Rate





New Haven Electric Trolley





Greater New Haven

Project Cost: \$1,510,081 Federal Funding: \$1,208,065 Cost Per Trolley: \$252,175 X 4





TROLLEY STOP

DOWNTOWN ELECTRIC TROLLEY 11 AM - 6 PM • MONDAY - SATURDAY • EVERY 15 MINUTES





Started Service August 12, 2002

Two Trolleys Route Length: 1.9 Miles <u>15 Minute Headways</u> Average-6 days a week <u>12 Hours a Day</u>





The project started in 2004 on a napkin. \$3,430,019 in funding from three years of Federally Directed Funds was released February, 2004. The whole project was supported by Congresswoman Rosa DeLauro, Former Sen. Dodd and Sen. Lieberman. The next \$8,000,000 was put together by Carla York, Innovation Drive, who manages our coalitions grant activities. Proterra is now located in South Carolina, primarily building Fast Charge Electric Buses .















BioWatz





The BioWatz grant consisted of \$738,000 in Federal Funds and \$1,507,057.73 total costs with the partner match from BioPur, Innovation Drive, and Sabre Engineering. The project had full support from Congressman Chris Murphy.







www.biowatz.com

Clean Cities / 21





Technology Introduction to Coalition Member

- Technology is moving very fast
- Electric Vehicle Systems Equipment (EVSE) Technology
- Smart Grid Interface
- Charging Data Collection
- Experts in High quality technology low production













Connecticut Clean Cities Future Fuels Project



Clean Cities Recovery Act: Vehicle & Infrastructure Deployment

Connecticut Clean Cities Future Fuels Project

Lee Grannis Principal Investigator Greater New Haven Clean Cities, Inc. Capitol Clean Cities — Hartford Southwestern CT Clean Cities — Fairfield Norwich Clean Cities Innovation Drive-Carla R. York — Project Manager





U. S. Department of Energy

www.cleancities.energy.gov







FUELS and VEHICLES General Approach



- Fuel neutral approach -
 - 5 fuels;
 - 9 locations;
 - 6 public access stations;
 - Major corridor ease of access for all public sites;
 - Ensures capability for statewide and regional mobility using Alternative Fuels

220 CNG Taxi's hitting the roads of CT – Metro Taxi in West Haven & The Yellow Cab Company in Bloomfield purchased 110 CNG vehicles each to fill up at the CNG stations commissioned at their facilities. (both stations offer public access.

- Fueling capability for the largest public transportation fleet of Hydrogen buses on the East Coast traveling over 200,000 miles per year in and around the Greater Hartford and Greater New Haven areas of the state
- Fleets and Fueling for three large commercial operations, representing 238 of the inproject vehicle deployments – representing 15 Million Miles Traveled Annually on busy Connecticut Highways and Interstates
- ARRA Federal Grant \$13,2 Million with Partner Match \$29 + Million Project Total



Vehicles – Approach



FUTURE FUELS PROJECT Navigating Our Transportation Energy Future









Strategic diversity with regard to fuel, application, vehicle class and geographic placement in the state ensures statewide mobility for >90% of the in-project deployments and increases future fuel load additions in this ARRA project funded through the DOE Vehicle Technologies Program - **11 fleets** (10 fully deployed, 1 fleet partial deployed) - 5 Fuels - CNG, LNG, Hydrogen, B20 and Electric – 5 Applications: Public Transportation, Municipal Fleets and 5 different Commercial Operations - 3 Classes: Light, Medium and Heavy-Duty Vehicles - 11 Zip Codes: Geographic diversity of locations, primary focus on heavily congested, high visibility areas - all positioned on or near Major Corridors

> 272 Vehicle Deployments





¹ Light Duty Hybrid



Project Infrastructure



FUTURE FUELS PROJECT Navigating Our Transportation Energy Future























Clean Cities / 26



Vehicles



FUTURE FUELS PROJECT Navigating Our Transportation Energy Future



















Clean Cities / 27



Follow on Non Grant Vehicles



FUTURE FUELS PROJECT Navigating Our Transportation Energy Future



12 LNG Tractor Fleet Privately Funded Cumberland Farms-Gulf



120 Vehicle AT&T Fleet fueling at West Haven and EnviroExpress Sites LNG and CNG Heavy Duty Trucks have been added to fleets and fueling.... driving petroleum displacements UP!





Privately Funded Additional Vehicles EnviroExpress



Fueling Approach/Locations



FUTURE FUELS PROJECT

Fueling Installations located on or near major corridors with Public Access stations positioned along heaviest traveled roadways

COMMISSIONED/OPERATIONAL

- Bridgeport- 1 LNG/CNG Station P
- Norwich NPU; 8 EVSE , B20, efficiency upgrade to existing CNG Station P
- West Haven- 1 CNG Station P
- Bloomfield- 1 CNG Station P
- Meriden-1 CNG Station
- Glastonbury- 1 CNG Station
- Fairfield-1 CNG Station
- Windsor Locks- 1 CNG Station P
- Hartford- 1 Hydrogen Station 1Qfy13





Site Openings



FUTURE FUELS PROJECT Navigating Our Transportation Energy Future



Fairfield CNG 10 June 2011



Clean Cities / 30

Stations

- 7 New Stations Completed and Operational in Meriden, Bridgeport, Fairfield, West Haven, Glastonbury, Bloomfield, and Windsor Locks
- ✓ 2 Fuel Station Upgrades Completed and Operational in Norwich at NPU + 8 new EVSE's
- 1 Station under construction with commissioning planned prior to end of 1QFY13
 - 2 Ribbon Cuttings still outstanding











Training & Media



FUTURE FUELS PROJECT Navigating Our Transportation Energy Future

Outreach/Education/Marketing Results

- ✓22 Events
- ✓1356 Event Attendees
- Media/Marketing Exposures 142,821,683
 (Calculated at 30% of Potential Viewers/Circulation)









Training Results

✓43 Training Classes✓1092 Attendees

Clean Cities / 31

Marketing/Media Activities

- ✓16 Press Releases Issued
- ✓ One major marketing collateral distributed throughout the state, to policy makers, fleet operators, regulatory officials and others across the state of CT (6,000)
- ✓15 Local/Regional TV Spots
- ✓5 Local/Regional Radio Interviews
- ✓87 Internet Publications
- ✓ 93 Local/National Print Publications (Newspapers)
- ✓ 11 Trade Publication Stories













Collaborations/Partnerships Project Team



FUTURE FUELS PROJECT

Greater New Haven Clean Cities - PRIME **Non-Profit** Capital Clean Cities Partners Norwich Clean Cities Southwestern CT Clean Cities Local • **City of Bridgeport** . Government • Town of Glastonbury Partner • City of Meriden Town of Fairfield ۰ Norwich Public Utilities (NPU) **Utilities** Southern Connecticut Gas Company Partners **Connecticut Natural Gas Corporation State Agencies** CONNDOT & Organizations **CTTRANSIT** Partners * Supporting • - Connecticut DECD 30 **Organizations** - Connecticut DEEP Partner - Yankee Gas Organizations

Private Industry Partners

- Innovation Drive 1st Tier Sub
- Sabre Engineering
- Signature Transportation
- Enviro Express
- Avalence
- Metro Taxi
- The Yellow Cab Company
- Clean Energy (CE)
- Air & Gas Technologies (AGT)
- Nana Corporation
- Baker Equipment
- Bonner Electric, Inc.
- Manchester Honda
- Matthews Bus
- Interstate Ford
- VPG
- Ford Motor Company

No designation indicates 2nd and 3rd Tier Sub or Supporting as indicated







Connecticut

Over the project's 4-year life the environmental benefits will include displacing (or eliminating):

- More than 6 Million Gallons of petroleum
- More than 11 Million pounds of Greenhouse Gases (GHG)
- Over 500 Thousand pounds of Carbon Monoxide (CO)
- Over 300 Thousand pounds of Nitrogen Oxides (NOx)
- Over 50 Thousand pounds of Volatile Organic Compounds (VOC), and,
- Over 3 Thousand pounds of Fine Particulate Matter (PM2.5)

Contact Information



Lee Grannis

Greater New Haven Clean Cities Coalition, Inc.

lgrannis@snet.net

203-627-3715





Upcoming Meetings

Month	Торіс
Dec 12, 2012	Meet the Regulators (PURA Members)
Jan 16, 2013	Legislative Preview (Jointly with CBA Public Utility Law Section)
Feb 13, 2013	Emerging Technologies
Mar 13, 2013	CT Energy, Environment and Economic Development Conference
Apr 10, 2013	UTC Fuel Cell Manufacturing Tour
May 19-21, 2013	New England Energy Conference and Expo, Mystic, CT
Jun 12, 2013	CPES Awards and Case Studies