



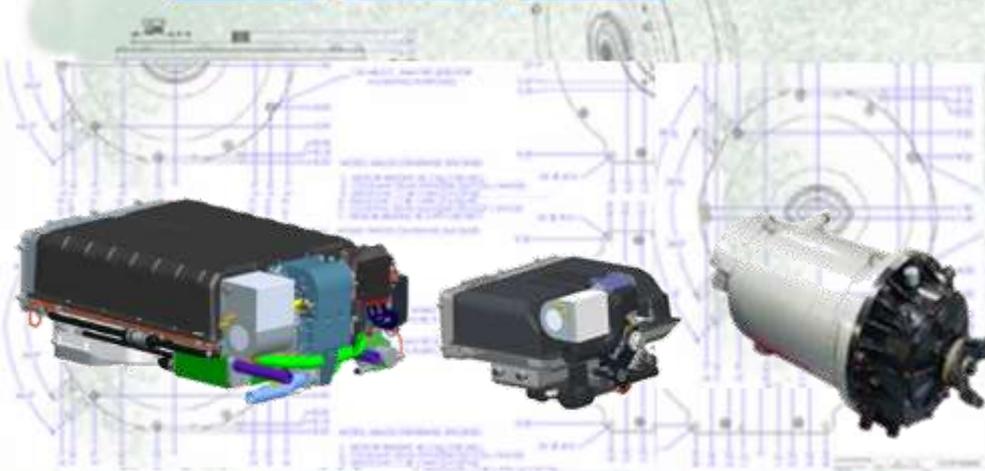
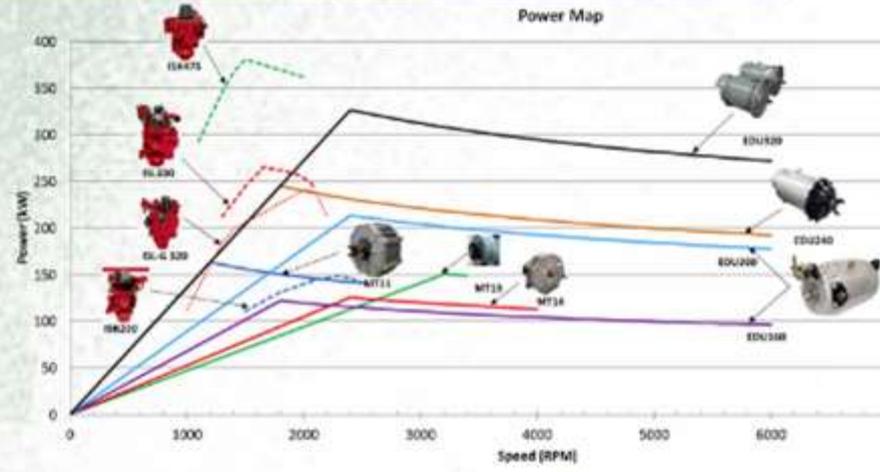
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US Hybrid



www.ushybrid.com

www.usfuelcell.com

www.magmotor.com

US Hybrid HQ: Torrance, CA

Year
Established

1999

Core
Competency

Electric Powertrain &
Auxiliary systems for
Electric, Hybrid and Fuel
Cell Vehicles

US FuelCell South Windsor, CT

Year
Established

2013

Core
Competency

Fuel Cell
Engines

Magmotor Corporation Worcester, MA

Year
Established

1876

(US Hybrid Acquired 2008)

Core
Competency

Servo Motors, Drives
Automation & Robotics



Torrance, CA



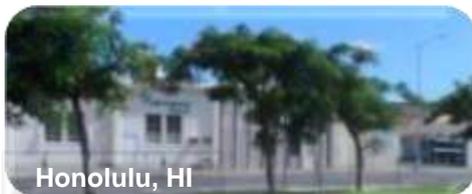
South Windsor, CT



Worcester, MA



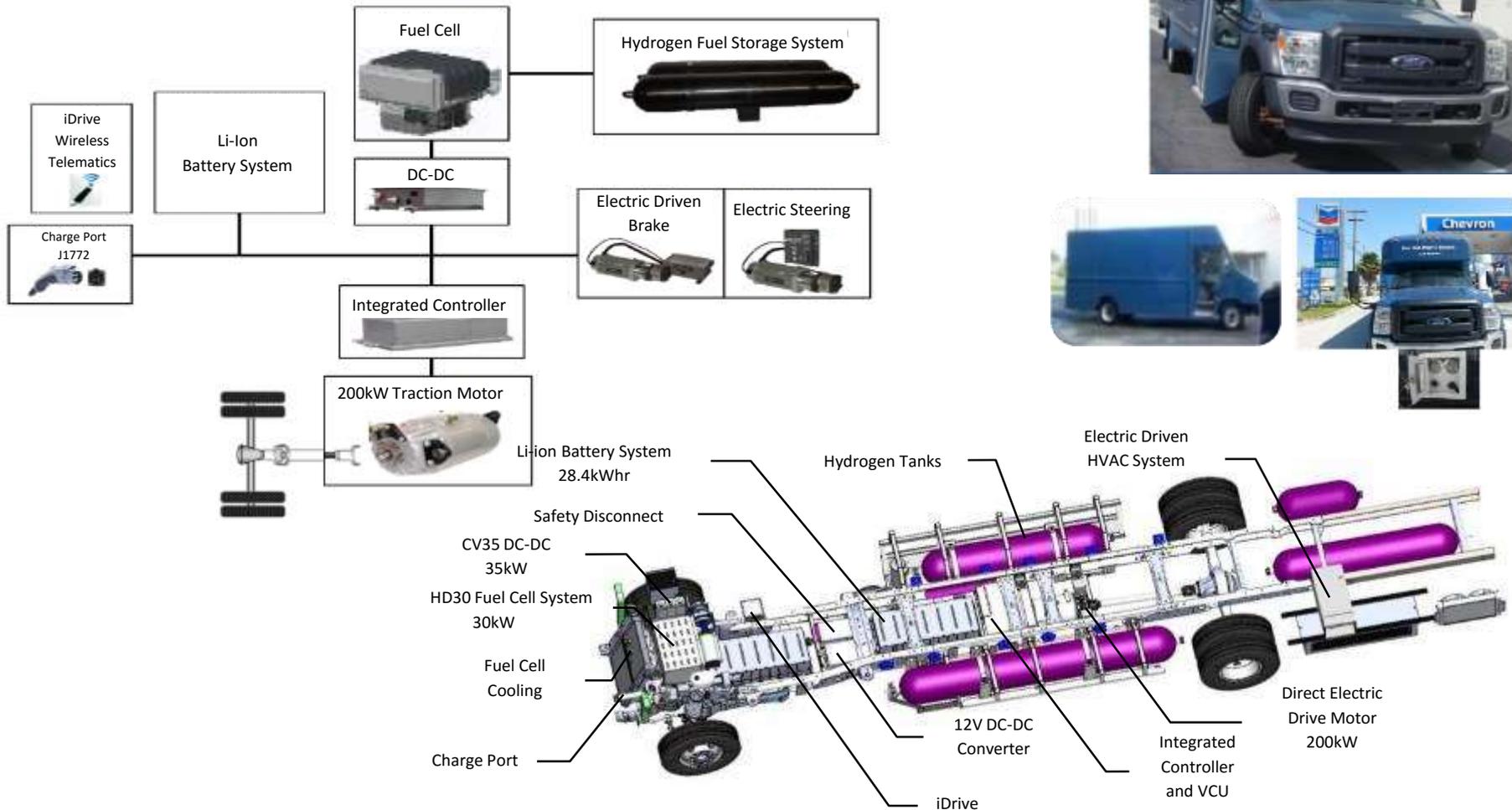
Torrance, CA



Honolulu, HI

US Hybrid Business Focus is
Medium and Heavy Duty Commercial Vehicles

Fuel Cell Powered Shuttle Bus, Utility truck and Cargo van Commercial Deployment





Electrical

Output Power†	6 - 80kW
Output voltage	375 - 750V _{DC} (Integrated dc-dc converter)
Ramp rate	50 kW/sec

Efficiency

System Efficiency†	56.9 to 46.3% (10% to full power)
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Temperature

Ambient Operating	-40 to 50°C
Cooling Inlet (50/50 WEG)	55 to 57°C

Fuel

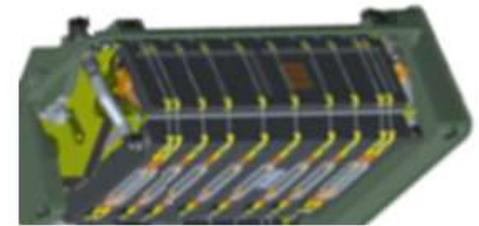
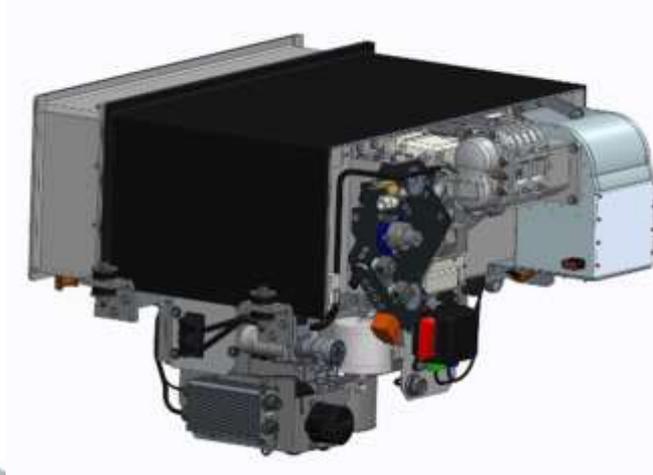
Fuel Flow	5.2 kg/hr @ full power
Fuel Pressure	1200 ±300 kPa _g
Fuel Type	SAE J2719 Hydrogen

Physical Characteristics

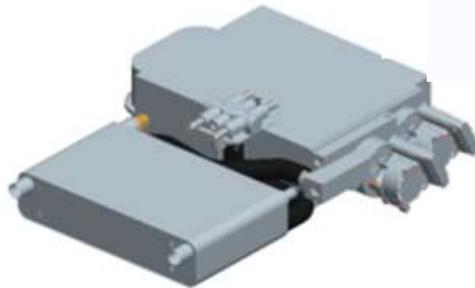
Dimensions (L x W x H)	916 x 879 x 614 mm
Weight	248 kg

Interface

Vehicle Communications	CAN SAE J1939
Startup	15 seconds
Startup from Frozen	6 minutes
Shutdown	10 seconds



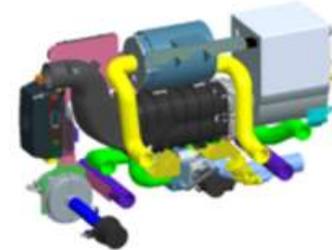
Cell Stack Assemblies



Thermal Management System



Fuel Processing System



Air Processing System

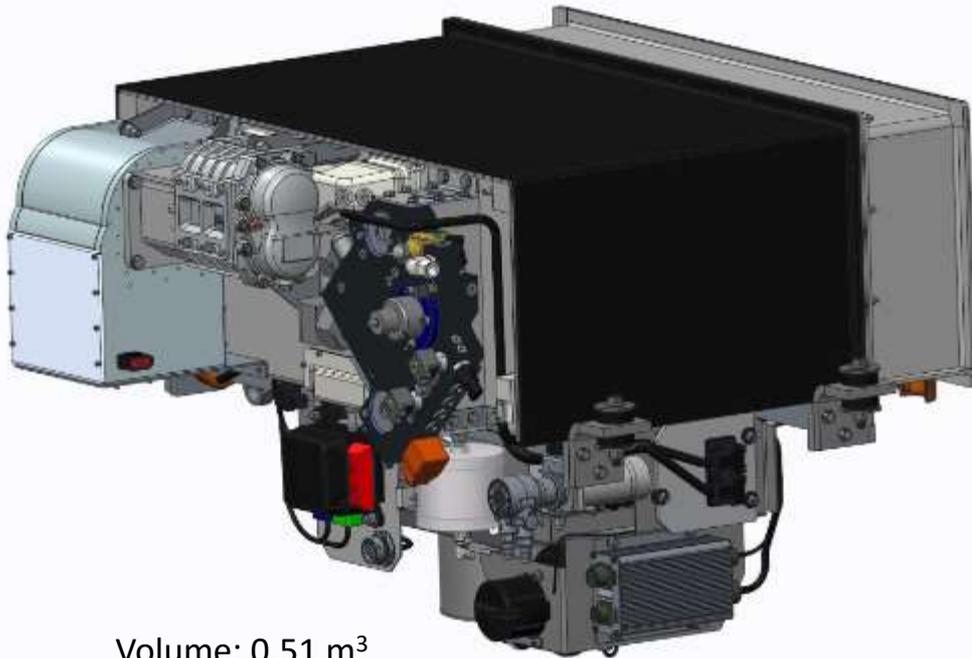
Integrated Solution for Medium and Heavy Duty Transportation

Life Cycle Cost

Power Density

SIZE matters

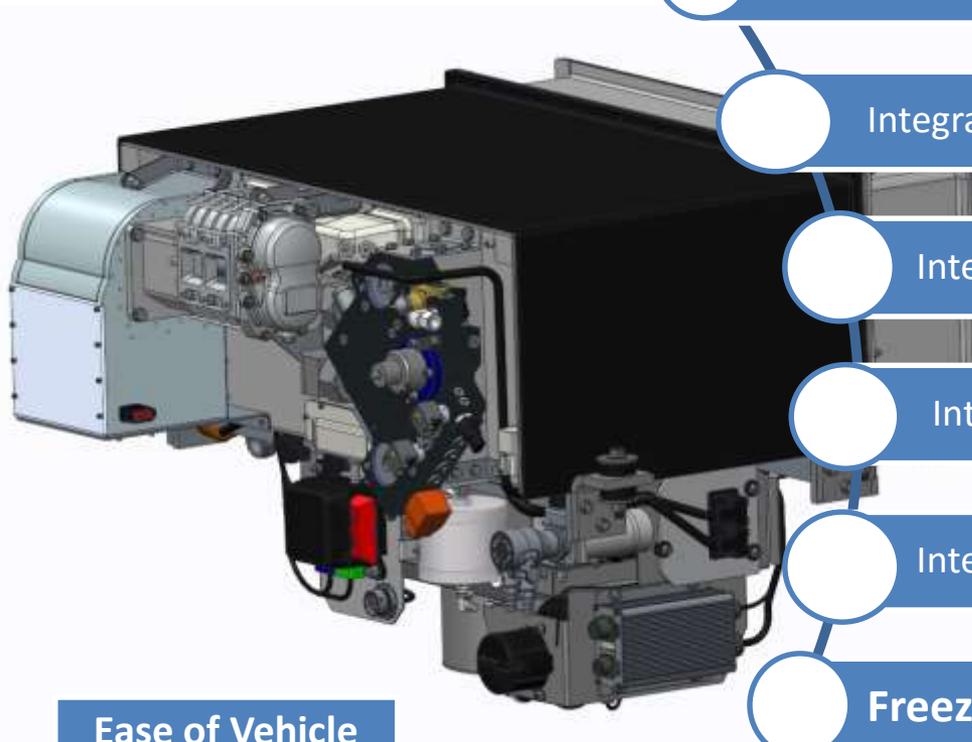
GHG Footprint



Volume: 0.51 m³
Weight: 190 kg



Volume: 1.6 m³
Weight: 1199 kg



Automotive Components, Accessible for service and Maintenance

Integrated Air Processing Unit

Integrated Fuel Processing unit

Integrated Thermal Management System

Integrated Isolated DC-DC Converter Technology

Freeze Capable

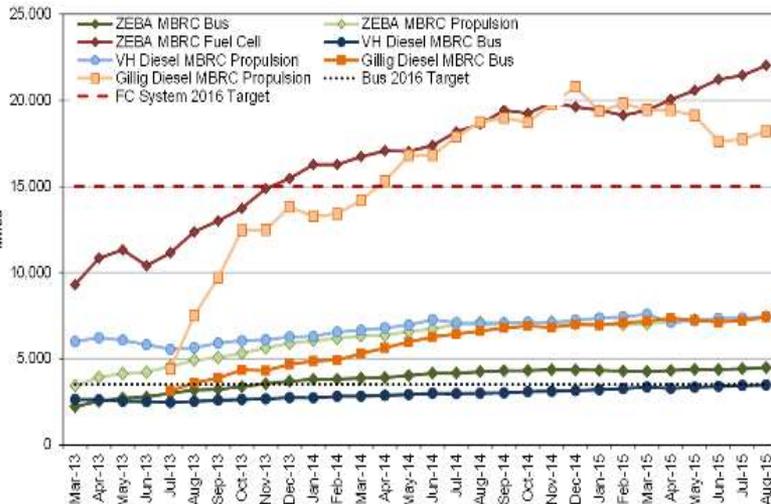
Integral Safety and Automatic Protection

Ease of Vehicle
Integration,
Operation and
maintenance

Technology Readiness Level (We are beyond this)**Business Case Readiness Level****Supply Chain (Market) Readiness Level****Quality of Service and Operation Readiness Level**

1. Operator and Service & Maintenance Readiness Level
 - a. Public, Management and operators
 - b. Facility and Infrastructure readiness
 - c. Equipment (Diagnostics tools, safety systems, First Respondent)
2. Work-Force Readiness Level
 - a. Operator Training
 - b. Training; Self/External Training, Continuous education, teaming with local/state agencies
3. Documentation Readiness Level (Should be included in contracting level)
 - a. Operator Manual
 - b. Service Manual (make sure your service people have accepted it).
 - c. Critical BOM List and cross reference for custom part numbers
4. Parts Inventory
 - a. Supplier/OEM long lead items
 - b. Off-the shelf parts

- **FC Transit bus has Proven Reliability, Maintainability and Efficiency**
- The Vehicle and power plant safety and protection system has shown to be **effective with no safety incidents.**
- Vehicle and Facility **safety system has functioned as designed**
- There is no evidence of riders concern/perception with safety (fear factor) and are noticing the quite and smooth ride conveniences.
- AC Transit service and maintenance teams step-up to challenge and performed all the service and maintenance and **deserve all credits.**
- US Hybrid has trained 22 of the AC Transit technicians and will continue in training curriculum development in cooperation with ACT, local colleges and job centers.



Fuel Cell Power Plant Miles Before Road Call "MBRC" exceeds Comparable Diesel Engine with After treatment

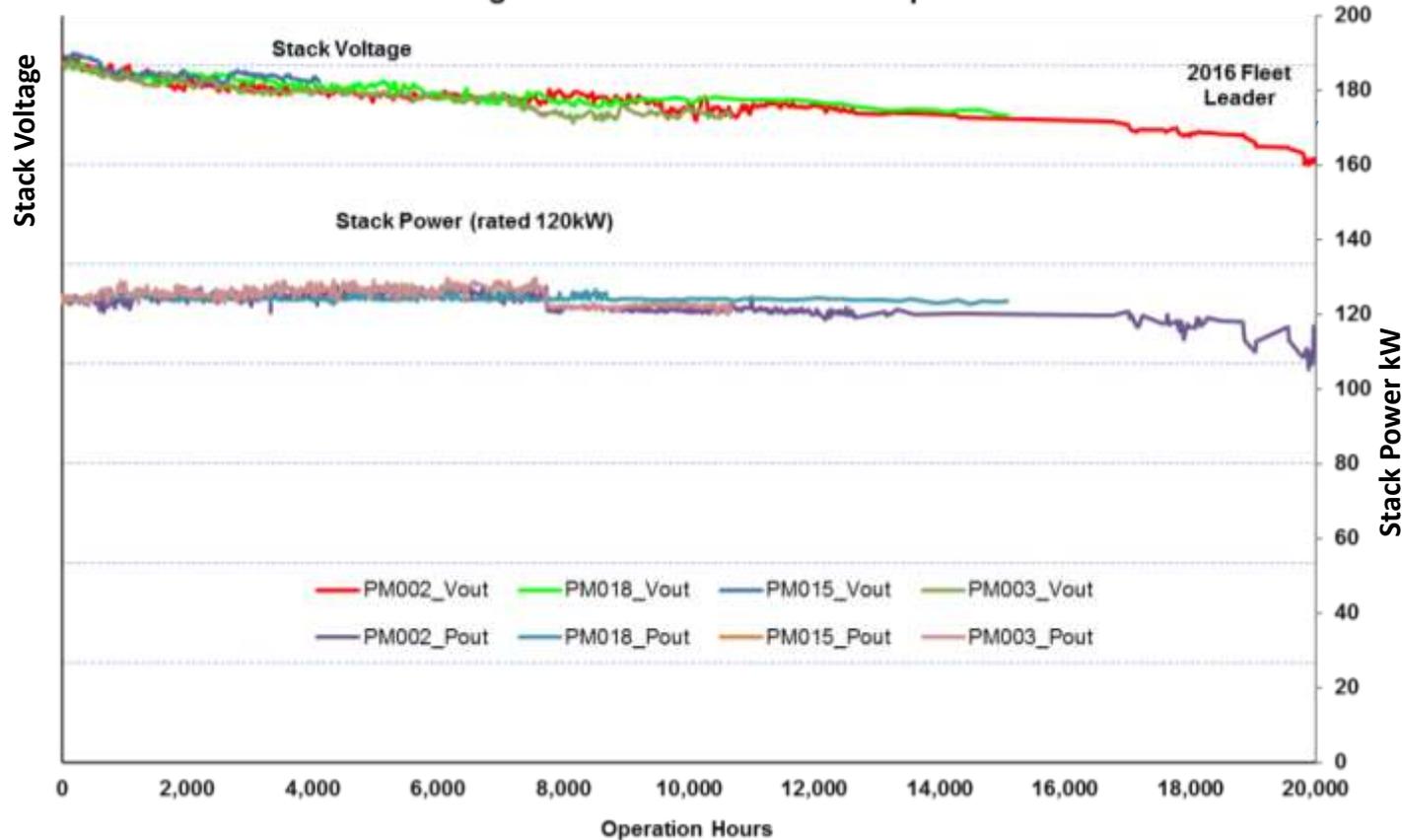
	ZEBAs	VH Diesel
Bus MBRC	4,315	3,427
Propulsion MBRC	7,180	7,171
FC System MBRC	20,045	14,500*

Data: NREL September 2011 through August 2015

How did we achieve Reliability;

- PC40 Fuel Cell engine has exceeded 21,000 hours of operation with ZERO failure
- Millions of Miles and hundred thousands of hours with Zero Stack failure and >90% total availability

Fuel Cell Stack Voltage and Power after 7 hrs. of operation at rated current



- **Diesel:** 37.1 kWh/gal (Energy content),
- **Gasoline:** 32.9 kWh/gal, (Energy content),
- **Hydrogen:** 39.7 kWh/kg, (Energy content),
(1kg H2 =11 gal @5000 psi, same as 2 gal of diesel fuel)
- **Energy Storage Density:** Li-Ion Battery

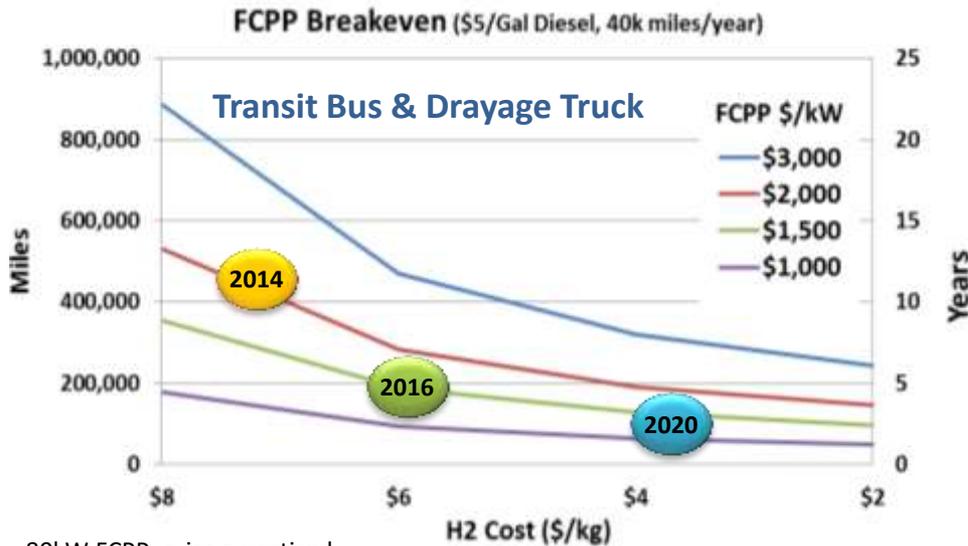
Engine Output: **4.5 kWh/kg**

Engine Output: **2.8 kWh/kg**

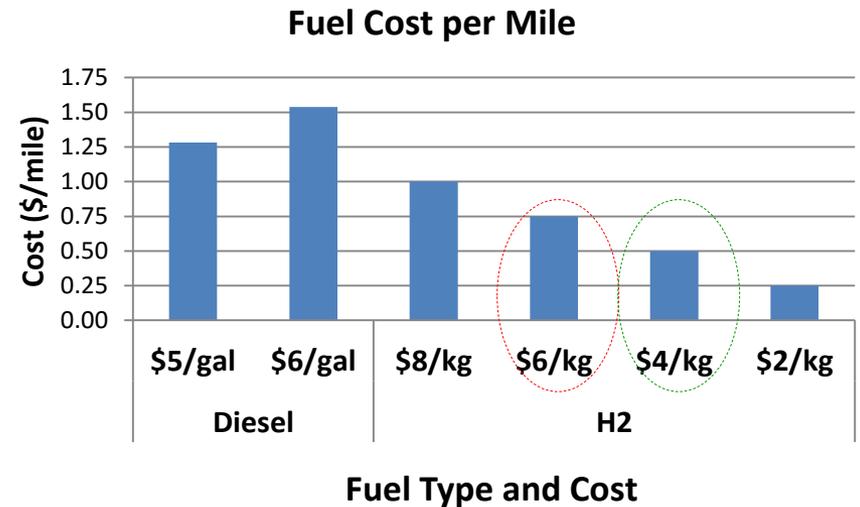
FC Engine Output: **15 kWh/kg**

0.11 kWh/Kg

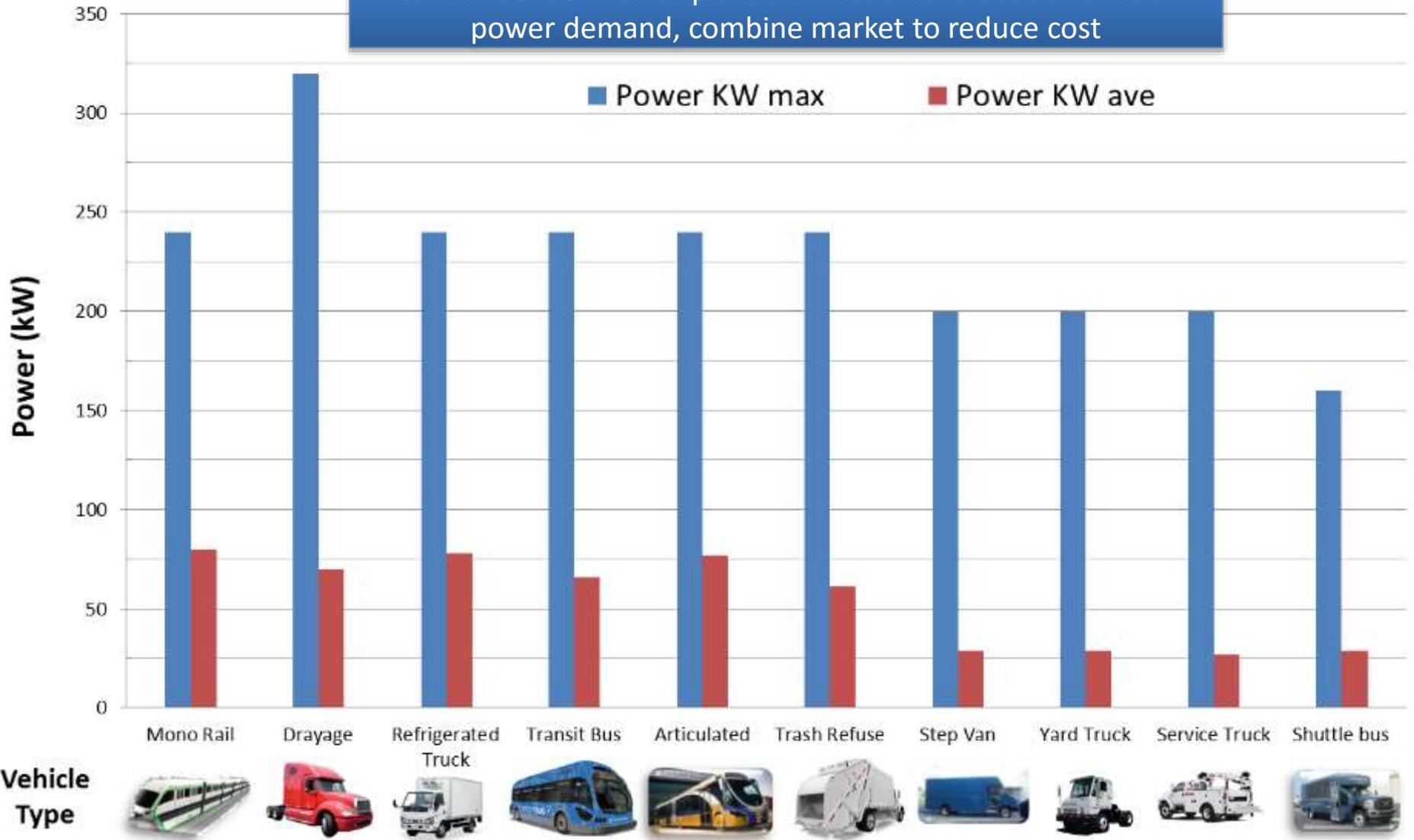
1kg of H2 (9 miles/kg) > 2-Gallons Diesel (3.8mpg) 40' Transit Bus
1kg of H2 (12miles/kg) > 2.5-Gallons Gasoline (5 mpg) Shuttle Bus



80kW FCPP, price amortized



80kW Fuel Cell Power plant can meet Transit bus and Truck power demand, combine market to reduce cost



Thank you !

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