Powering Possibilities with Infinite Drive

- Innovative manufacturing facilities in NY and WA
- Been in business since 1999

- Premier list of customers: P&G, Walmart, Kroger, BMW, Home Depot, Lowes

- More than 13,000 units in the field
  - >110 million hours of runtime by material handling customers
  - Supporting 95 distribution centers

- Focused Expansion Opportunities
  - 180+ issued patents
    - Hydrogen storage & generation
    - Motive power applications
    - Stationary Power Applications

Plug Power’s competitive advantage is in its ability to create value by providing tools that enable our customers to operate more efficiently and cost effectively!!
Operational Variables

- Non Productive Time
- Managing and Maintaining too many Assets
- Variable Productivity Performance
- Operational Flexibility
- Energy Expense

Space Limitations
- Monitoring & measuring Performance Levels
- Managing Expenses

Labor Management
- Fleet Scalability
- Safety Liabilities
- Process Standardization
- Equipment Utilization Rate
A typical hydrogen fuel cell solution can generally realize an IRR > 15% with a payback < 3yrs, > $1M in savings!
Reformer – Onsite Hydrogen Generation
Class 1
Sit-down Lift Trucks
8 kW, 10 kW
36v, 48v or 80v

Class 2
Stand-up Reach Trucks
8 kW, 10 kW
36v or 48v

Class 3
Rider Pallet Trucks
1.8 kW, 3.2 kW
24V
Electrical Energy Generation Process

Hydrogen + Oxygen → Water + Electricity

Electron Exchange in the MEA (Membrane Electrode Assembly)

Protons and Electrons Flow through the MEA

Oxygen reacts with Protons and Electrons to produce Water and Heat.
The explosive energy of hydrogen is approximately:
• 1/3rd that of natural gas
• 1/10th that of propane
• 1/20th of gasoline.
• The presence of carbon in natural gas and propane increases their explosive potential, whereas hydrogen is carbon-free. This means the gasoline we use in our cars today has over 20 times the explosive potential of hydrogen.

The auto-ignition temperatures of hydrogen and natural gas are very similar.

Both have auto-ignition temperatures over 1,000°F, much higher than the auto-ignition temperature of gasoline or Propane vapor. This adds to the safer handling of hydrogen.
Photo compares fires from an intentionally ignited hydrogen tank release to a small gasoline fuel line leak.

• The maximum temperature inside the hydrogen car’s back window was ~ 67°F!
• The gasoline car continued to burn for several minutes and was completely destroyed.
• Hydrogen rises at 20 m/s

Photo/Text: Dr. Swain, University of Miami.
Ground Support Equipment (GSE)

- **Pushback Tractor**: Pushes airplane backwards away from the gate.
- **Ground Power Unit**: Supplies power/air conditioning to the aircraft while at gate or during loading.
- **Container Loader**: Loads containers from ground level to aircraft by lifting via a platform.
- **Airstart**: Provides the initial rotation to start gas turbine engines.

- **Belt Loaders**: Loads from ground level to aircraft storage areas by way of conveyor belt.
- **Cargo Tractors**: Transports cargo from plane to sorting facility.
Expanding Customer Base
Creating A Competitive Advantage Requires Risk and Embracing Change!!
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