The Accelerating Acceptance of Fuel Cell Technology

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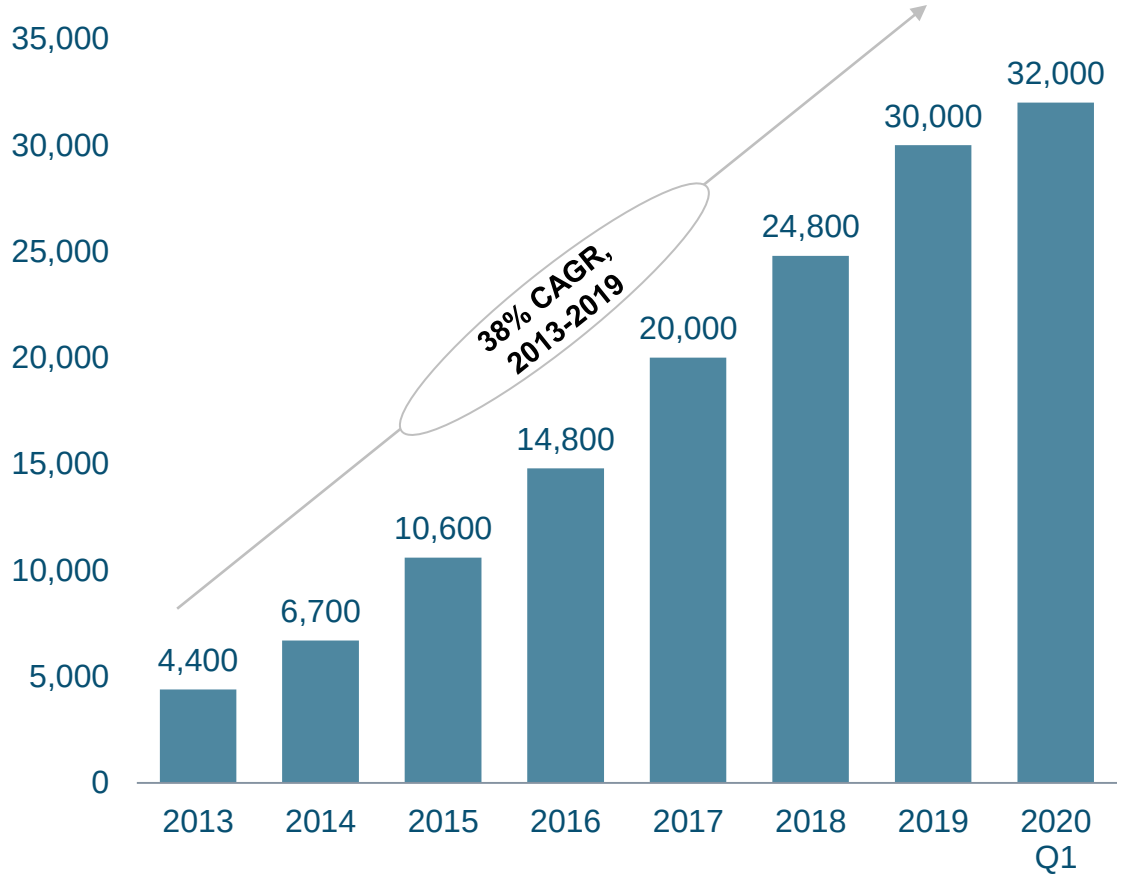
Plug Power Overview: Leader in Hydrogen and Fuel Cell Technology

Key Performance Characteristics

- 1st to create a market for HFC technology
- Strong patent portfolio and proprietary know-how
- 44 trademarks
- ~70% blue chip customer base
- 300MM+ operating hours (1Bn+ miles)
- Significant runway available in core forklift market
- Future applications represent tremendous addressable markets
- 27.9MM+ fuelings; 27T+ liquid H_2 used daily
- Installed base creates foundation for recurring revenue

Cumulative Hybrid Fuel Cell Units Installed (1)



Growing the Installed Base and Hydrogen Consumption → Future Recurring Revenue

Note:
1. Rounded figures, excludes stationary units

Plug Power Overview: Product and Service Solutions

GENKEY

Complete Turnkey Solution

Fuel Cell Technology

GENSURE

Fuel Cells for Stationary Applications

- 10,000+ units in the field worldwide
- High reliability with 99.6% uptime
- Environmentally hardened from – 20°F to 120°F

GENDRIVE

Hybrid Fuel Cell Solutions for Forklifts

- ~32,000 units in the field
- Drop-in replacement
- 300MM+ operating hours

PROGEN

Fuel Cell Stacks and Systems

- High-power, air-cooled, and liquid-cooled designs
- Lower cost / higher performance
- 28+ years of Plug Power IP

GENFUEL

Fueling Infrastructure and Delivery

- 80+ installed sites
- 300+ hydrogen dispensers
- 27.9MM+ fuelings; 27T+ liquid H_2 used daily

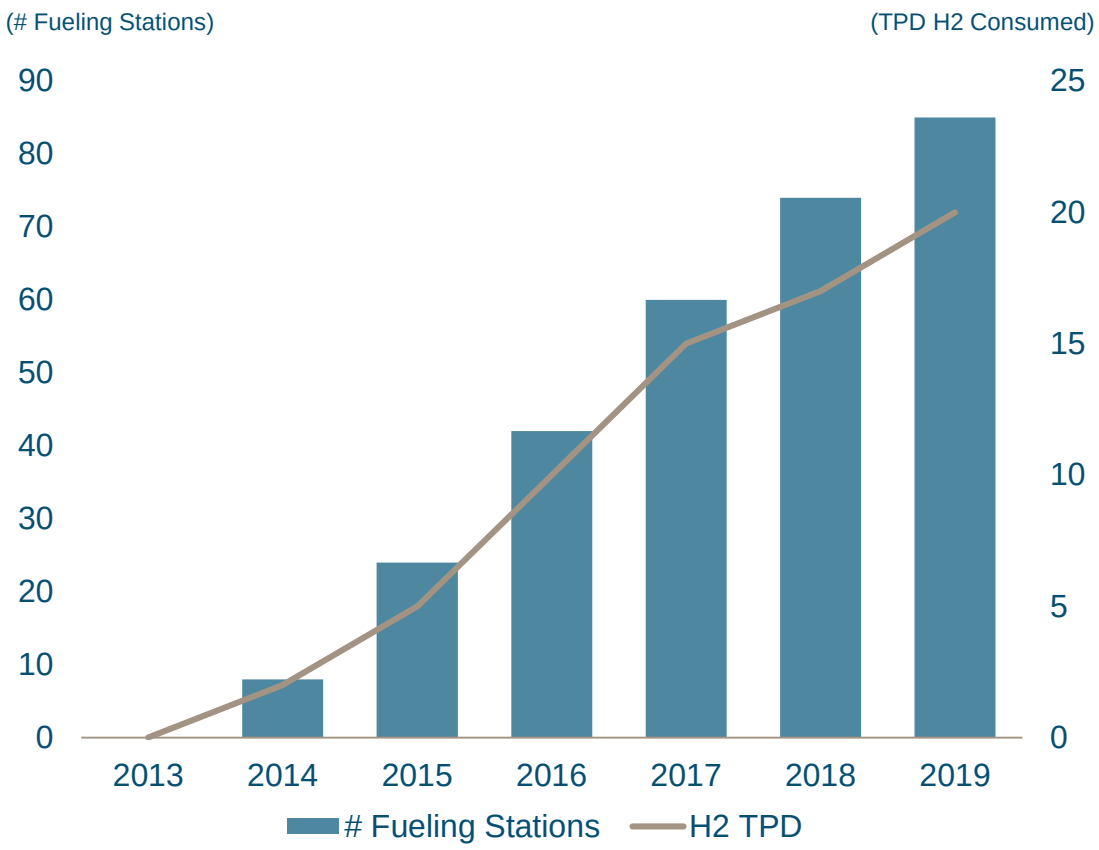
GENCARE

Complete Service and Maintenance

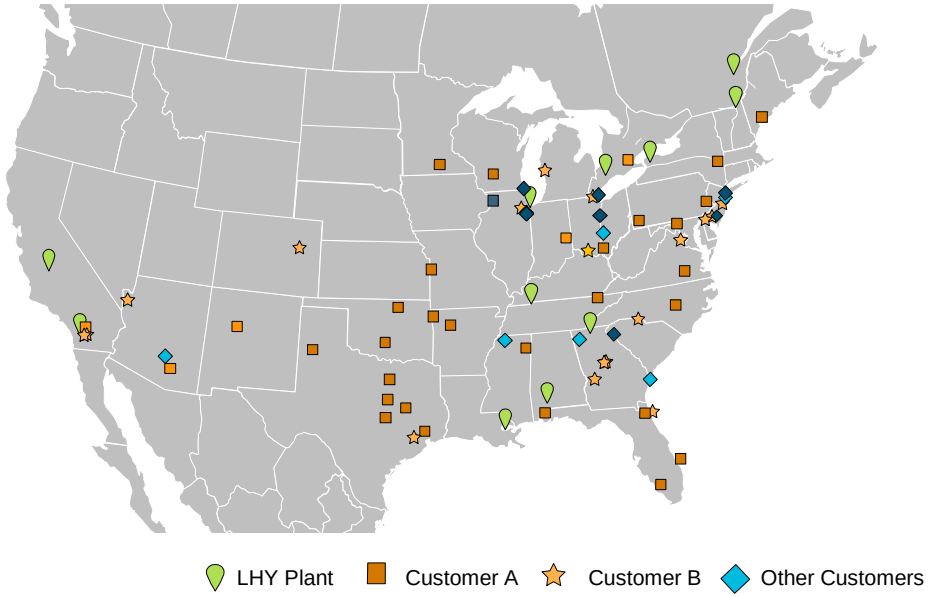
- 98+% uptime performance
- IoT data collection, monitoring and control driving efficiency and uptime

Plug Power Overview: Leader in Hydrogen Fueling Networks

Hydrogen Infrastructure and Fuel Consumption: 2013 - 2019



Hydrogen Infrastructure Footprint: To Date



80+ fueling stations in operation

Largest user of liquid hydrogen (27T+ used daily)

16.8MM+ kgs dispensed (cumulative)

27.9MM+ fills on GenFuel systems (cumulative)

Plug Power Overview: Market Opportunity

Material Handling	Electric Vehicles	Stationary Power	Hydrogen Economy
$30Bn	**$300Bn**	**$15Bn**	**$2.5Tn**
Target addressable market	*Target addressable market*	*Target addressable market*	*Target addressable market*

Plug Power Today ***Long-term Growth Trajectory***

Forklifts

- More than 6MM forklifts deployed
- 1.5MM forklifts sold annually

On-Road Electric Vehicles

- Energy density is ~10x BEVs
- High asset utilization
- Enables sharing economy
- Faster fueling
- Longer range
- Infrastructure expertise
- Less challenging operating conditions than material handling applications
- Constant power

Data Centers & Wireless Infrastructure

- Small footprint, high power density
- Lower TCO vs. diesel generators

Hydrogen & Equipment

- The Hydrogen Council projects than by 2050, hydrogen could provide up to [1] :
  - 18% of final energy demand
  - 6Gt annual CO2 abatement
  - 30MM jobs created

Note:
1. Based on 2017 Hydrogen Council report

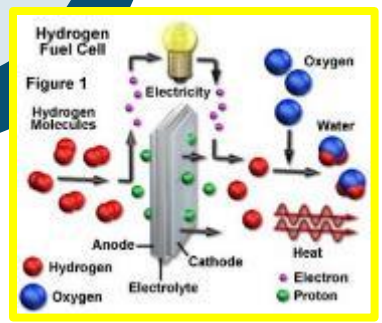
Plug Power Overview: Blue Chip Customers

◆ Multi-site Customer

Drop-in Hydrogen Fuel Cell Solution

Fuel cells – A breakthrough solution for MHE

Inputs: hydrogen & air
Outputs: electricity & water



Fuel cell, small battery, tank, control systems, ballast

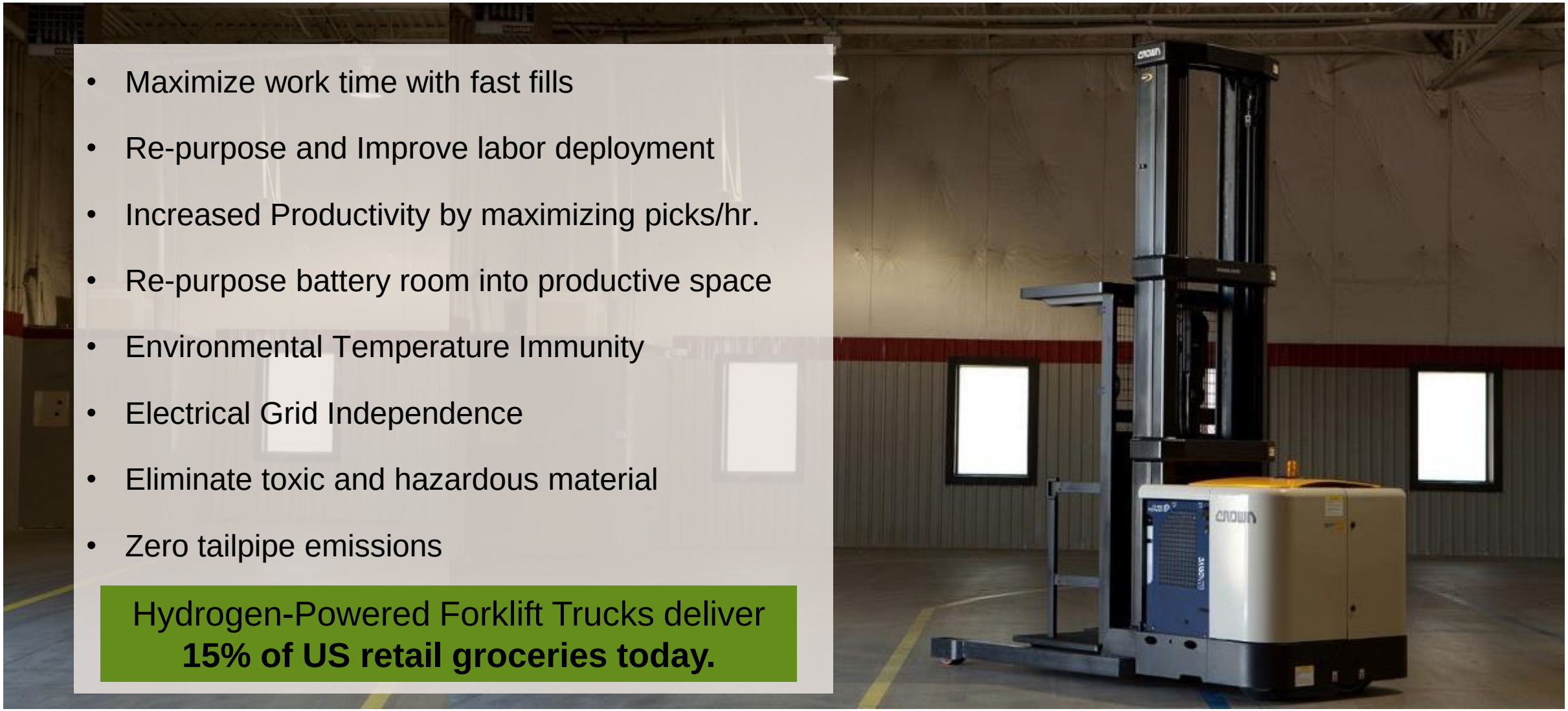
Drop in replacement for conventional batteries

Constant output voltage – no droop if SOC drops below 50% !

90 seconds to refuel!

Intelligent and data rich power solution!

Proven Solution for Forklift Trucks



- Maximize work time with fast fills
- Re-purpose and Improve labor deployment
- Increased Productivity by maximizing picks/hr.
- Re-purpose battery room into productive space
- Environmental Temperature Immunity
- Electrical Grid Independence
- Eliminate toxic and hazardous material
- Zero tailpipe emissions

Hydrogen-Powered Forklift Trucks deliver
15% of US retail groceries today.

The Future is Now – Why Electric Vehicles?

Why EVs

1. Design Simplicity
2. Lower Total Cost of Ownership
3. Higher Reliability
4. Self-Driven Vehicles / Autonomy
5. Climate Change

Why FCEVs

1. Power Density is 10x BEVs
2. Asset Utilization
3. Sharing Economy
4. Fast Fueling
5. Range

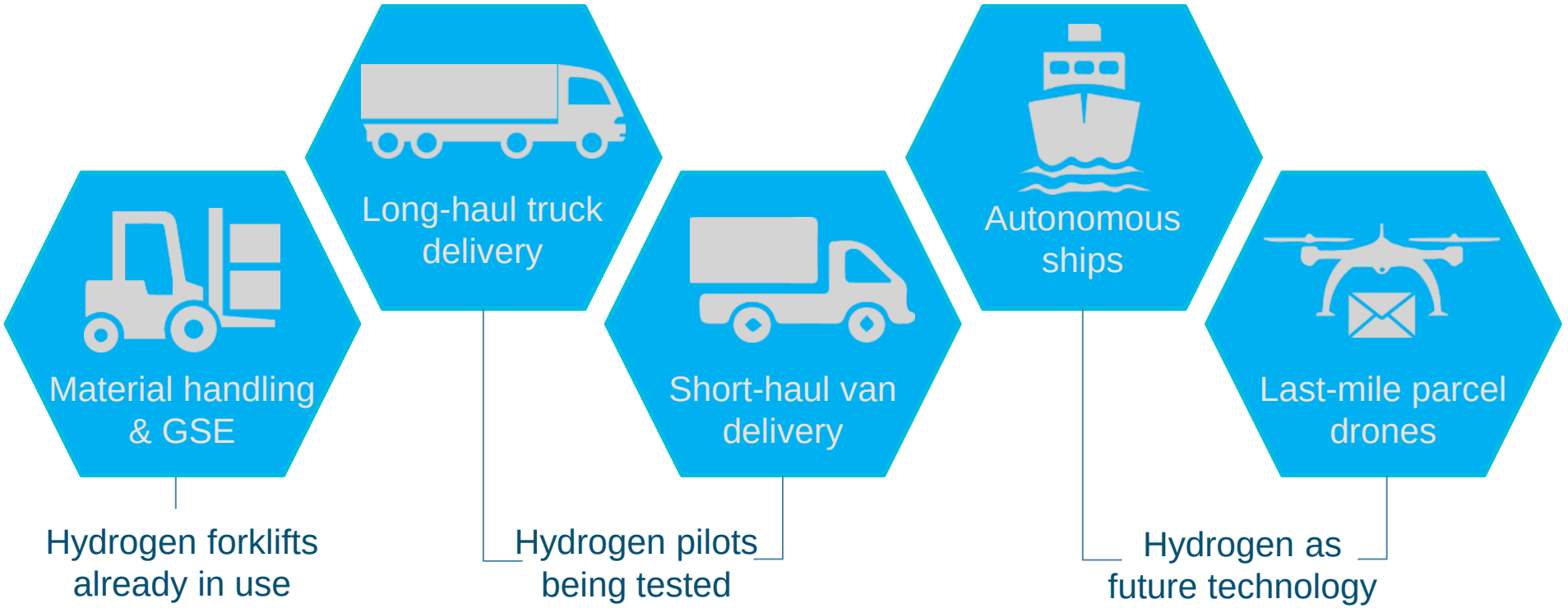
FCEVs are ideal for asset-intense logistics applications.

EVs: electric vehicles
IC: internal combustion

Logistics: Hydrogen is the Right Solution

Hydrogen can efficiently move goods from the warehouse to the door

Hydrogen technology status



The Hydrogen Council, "Hydrogen Meets Digital", 2018

Attractive Markets for H2

1. Captive fleet - Equipment remains in confined area

- **Advantage for service**
  - Personnel, parts inventory, service tools optimized across terminal fleets
- **Advantage for hydrogen fueling**
  - Infrastructure shared among port terminals
  - Mobile refueling trucks bring hydrogen from a central station short distance to fuel vehicles

2. Economical hydrogen fuel cost

- Amortize significant fuel usage over infrastructure cost to drive lower overall H2 $/kg
- Heavy utilization and high energy intensity

3. Zero Emission

- No local emissions
- Obvious local air and health benefits

4. Hydrogen as an Enabler for Electric Vehicles

- Inability to pause operations to charge batteries
- Extend range of battery electric vehicles to meet time and distances requirements at port

Largest Captive Fleets - Ports

TARGET ASSETS TO MAXIMIZE HYDROGEN UTILIZATION

POLA Asset / % of Cargo Handling Equipment

- Yard Tractor – 48%
- Forklift Trucks – 24%
- Top Handler / Top Pick – 9%
- RTG - rubber tire gantry crane – 5%

Other

- Class 8 Trucks
- Lesser impact - buses that transport operators

Attractive Characteristics

- Large % of port fleet
- Heavy utilization
- High energy intensity
- Inability to pause operations to charge batteries

Yard Tractor (UTR)

Top Handler

RTG Crane

Class 8 Trucks

Feedback From Ports

STATE IS PUSHING TOWARD ZEV AT ALL CA PORTS BY 2030. PORT OPERATORS ARE CONCERNED.

Zero emission options – batteries or fuel cells

“Problem is, batteries don’t work yet. If it could charge for 30 minutes and run for 8 hours, it could work” – Terminal Operator

CONCERNS WITH BATTERIES:

- Vehicle range anxiety
- Demonstrated battery electric vehicles lasted only 3 hours
- Battery changing
  - Managing multiple batteries per asset
  - Vehicle downtime
- Expensive charging infrastructure
- Working with ports to provide necessary utilities
- Reduced fuel economy due to battery weight

Hydrogen fuel cells have an opportunity to provide superior zero emission benefits:

- Fast refueling
- Larger onboard energy refueling
- Last full shift on one refuel
- Minimal infrastructure space
- No need to change port utilities
- Fuel costs go down with fleet size

Feedback From Ports

ALIGN WITH VEHICLE OEMs ALREADY ACCEPTED BY PORT OPERATORS

Operators are concerned about alternative fuel vehicles. They will be cautious.

- **Technology is not proven in ports.**
- **Align with someone they trust - Want parts and support from a major manufacturer, someone that is going to be around for the life of the equipment being 10-12 years.**

We have 720 diesel yard trucks in our fleet. 52% are Capacity; 46% are Kalmar/Ottawa. They are familiar.

A company recently presented a battery electric yard truck with a different setup. Labor was not impressed. The drivetrain was fine. But the trucks were not comfortable and the controls were in the wrong place.

– POLB Port Authority, paraphrased

Feedback From Ports

SPACE FOR FUELING / CHARGING INFRASTRUCTURE NEEDS TO BE ABSOLUTELY MINIMAL

- **Real estate is a major concern.**
- **Port land is some of the most expensive for cargo transport at $2k / acre / year.**
- **Infrastructure takes working revenue land away.**

H2 infrastructure can achieve 4,000 kg in a 40’ x 40’ footprint.

Scales favorably.

- **H2 Capacity: 15,000 gallons**
- **Liquid temp: -253 deg C**
- **Liquid Pressure: 5 PSI**
- **Gaseous Storage: 60 kg**
- **Gaseous Fuel Pressure: 350 bar**
- **Dispensing Time: 1 kg/min**

Feedback From Ports

THE BIGGEST IMPEDIMENT TO DEMONSTRATING H2 VEHICLES IS THE FUELING

- **Economics**
  - **<u>Demo Scale:</u> For 1 H2 yard tractor using 20 kg/day, a mobile refueler with gaseous hydrogen and compression capability is required. $200/day rental + $14/kg*20/kg = $24/kg hydrogen.**
  - **<u>Large Scale:</u> Hydrogen scales favorably (see below):**

Port Operation - 5 Days per Week						
Daily Hydrogen Usage	kg/day	250	500	1,000	2,500	5,000
H2 Molecule	$/kg	$4.50	$4.50	$4.50	$4.50	$4.50
All-In H2 Cost	$/kg	$8.73	$6.99	$6.34	$6.06	$5.88
Diesel Equivalent	**$/gallon**	**$3.49**	**$2.79**	**$2.54**	**$2.43**	**$2.35**

Port Operation - 7 Days per Week						
Daily Hydrogen Usage	kg/day	250	500	1,000	2,500	5,000
H2 Molecule	$/kg	$4.50	$4.50	$4.50	$4.50	$4.50
All-In H2 Cost	$/kg	$7.54	$6.29	$5.82	$5.62	$5.49
Diesel Equivalent	**$/gallon**	**$3.02**	**$2.51**	**$2.33**	**$2.25**	**$2.20**

H2 infrastructure needs critical mass to be economical.

Demo performance needs to be projected using large scale pricing.

Feedback From Ports

HYDROGEN DEMOS HAVE AN UPHILL BATTLE DUE TO PRIOR NEGATIVE ALT FUEL EXPERIENCES

- **Fred Johring, President of Golden State Express recommends "Make sure that the technology is ready because the port operators are very skeptical and already have a negative view."**

- **With the help of state incentives, his company purchased natural gas Class 8 yard dogs that were seriously undersized by the OEM.**
  - **Rated capacity: 66,000 lbs.**
  - **Required capacity: 80,000 lbs.**

"These trucks should have been built to handle 125,000 lbs.

If the drivers can get away with it, they'll do it."

– Fred Johring

- **Hydrogen demos needs to be ready for vehicles to be overused and abused.**

- **A pool of about 10,000 port drivers talk amongst each other so the ups and downs of new technology will be communicated very quickly.**

- **Service coverage will specifically be scrutinized. Parts availability, technical support, and escalation needs to be available immediately. Downtime due to service will not be tolerated.**

Market Expansion: Commercial Fleet Vehicles

Fuel Cells: Zero Emission Technology of Choice

- Extended Range
- High Asset Utilization
- Increased Payload
- Fast Fueling
- Lower Cost Infrastructure at Scale

500 Kilometer Range
100 Vans in 2020
Express or City Routes

***"80 to 90 percent** of the express fleet can ultimately only be covered by vehicles with a box body and hydrogen."*
~Markus Reckling, DHL

Ships and Long Haul Vehicles

- Hydrogen is **the ideal solution** for heavy duty long haul
- Over **10x energy density** of batteries
- Refill times and range **similar** to diesel
- **Avoid** expensive grid charging infrastructure
- **Full payload** capability
- More **reliable** and less maintenance
- **Lower** operating and ownership costs

Lower Total Cost of Ownership than Batteries with Better Performance

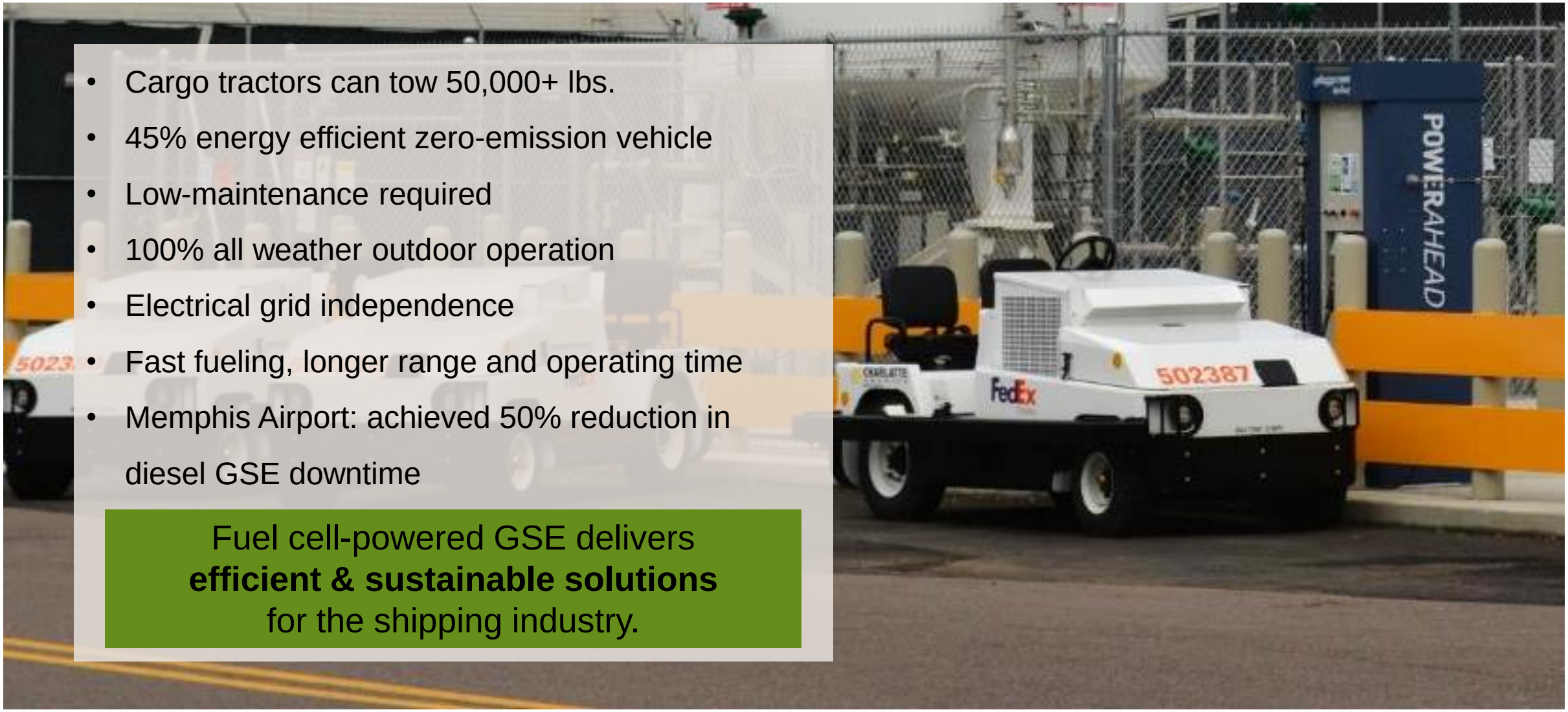
Hydrogen & Fuel Cells at Ports

The Project Portal "Beta" truck under test runs at the Ports of Long Beach and Los Angeles. Source: Toyota USA

Photo of the hybrid fuel cell-battery-powered container handler under development by Hyster for use in California. Source: Hyster

- **HFC provide the long run time, quick refueling, and quiet, efficient power required to meet the fast-paced and constantly moving demands of ports**
- **The port also provides an ideal environment for hydrogen energy and fuel cells, offering centralized, large-scale production, storage and refueling sites for various applications**

Hydrogen Fuel Cells for GSE



- Cargo tractors can tow 50,000+ lbs.
- 45% energy efficient zero-emission vehicle
- Low-maintenance required
- 100% all weather outdoor operation
- Electrical grid independence
- Fast fueling, longer range and operating time
- Memphis Airport: achieved 50% reduction in diesel GSE downtime

Fuel cell-powered GSE delivers **efficient & sustainable solutions** for the shipping industry.

Drones

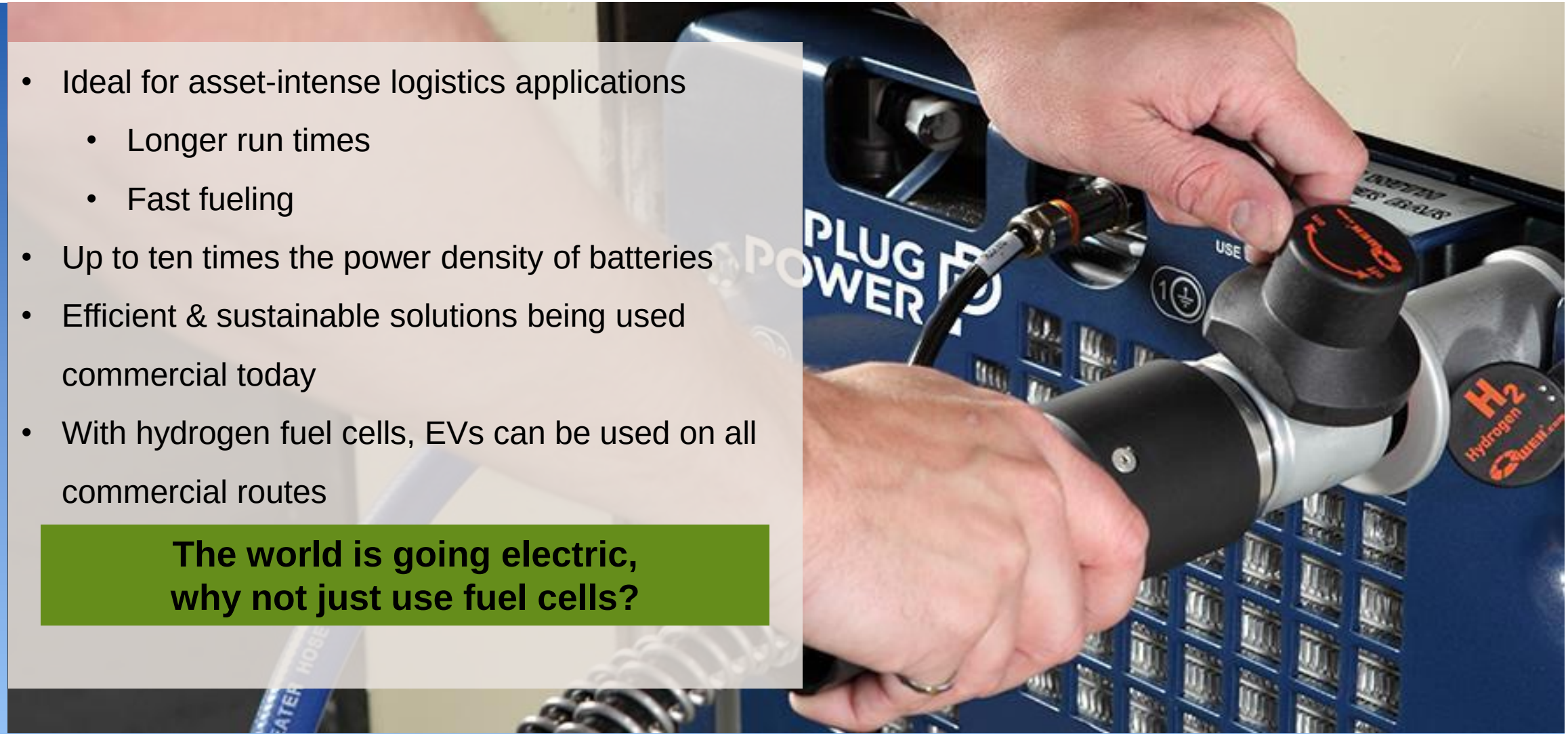
- Twice the Range of Lithium Batteries
- Higher power density post 20 minutes of runtime
- Fast refills (minutes)
  - Eliminates re-charging of batteries
- Up to 10 times the life of lithium batteries

The Ideal Application for Fuel Cells

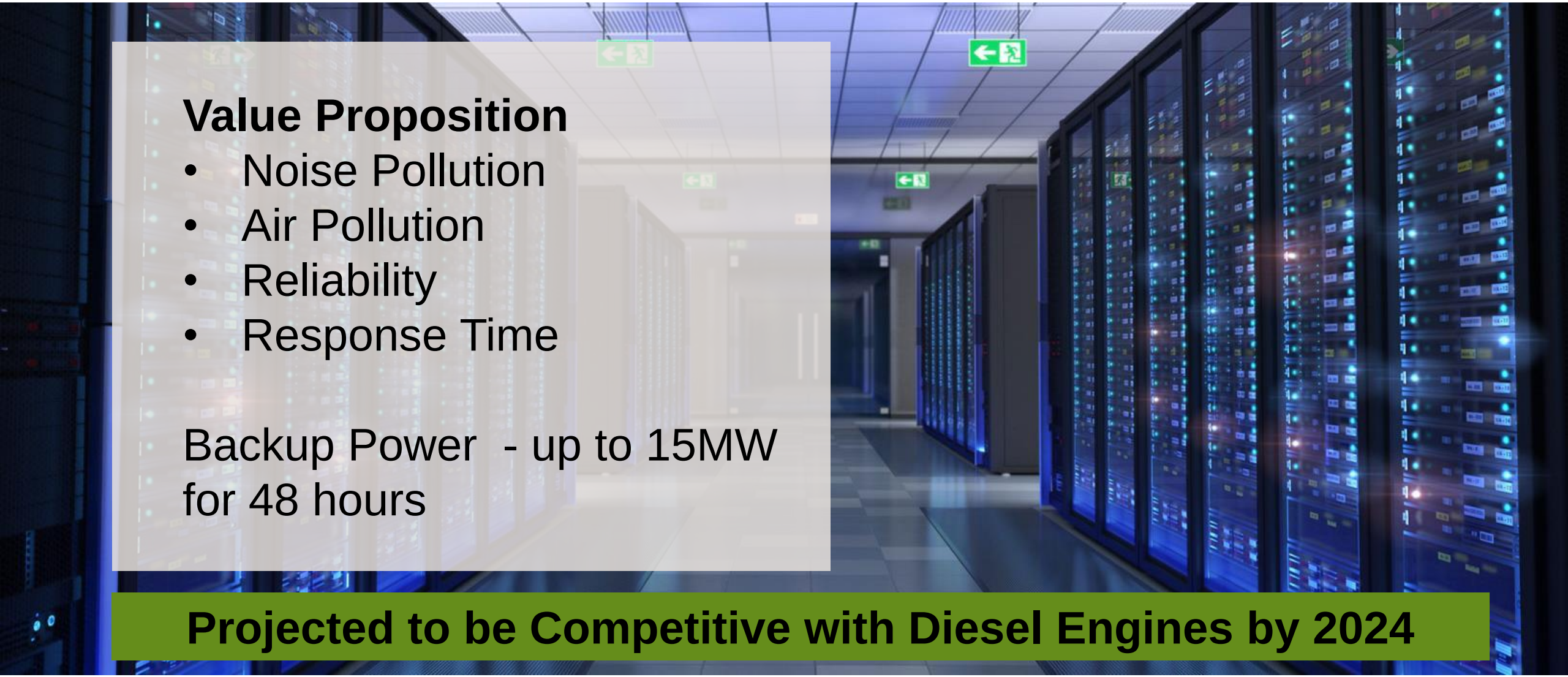
Hydrogen Fuel Cells Impact EV Logistics

- Ideal for asset-intense logistics applications
  - Longer run times
  - Fast fueling
- Up to ten times the power density of batteries
- Efficient & sustainable solutions being used commercial today
- With hydrogen fuel cells, EVs can be used on all commercial routes

The world is going electric, why not just use fuel cells?



Future Data Centers – Large Scale Backup Power



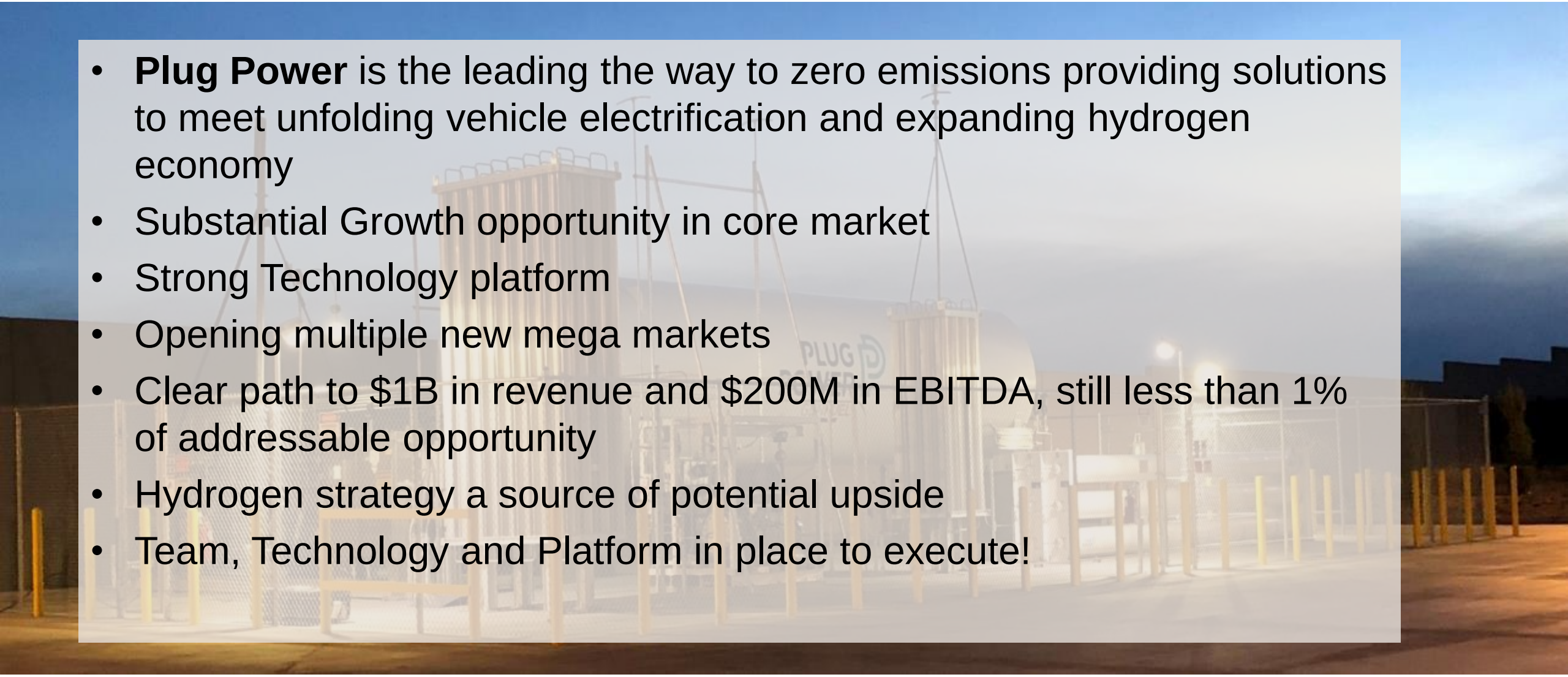
Value Proposition

- Noise Pollution
- Air Pollution
- Reliability
- Response Time

Backup Power - up to 15MW for 48 hours

Projected to be Competitive with Diesel Engines by 2024

Summary



- **Plug Power** is the leading the way to zero emissions providing solutions to meet unfolding vehicle electrification and expanding hydrogen economy
- Substantial Growth opportunity in core market
- Strong Technology platform
- Opening multiple new mega markets
- Clear path to $1B in revenue and $200M in EBITDA, still less than 1% of addressable opportunity
- Hydrogen strategy a source of potential upside
- Team, Technology and Platform in place to execute!

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