



Cummins Perspective on Fuel Cells

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Cummins powers a broad range of applications with diverse requirements

- The world's largest independent engine manufacturer
- Global manufacturing
- Broadest and most capable distribution and customer support network
- Powering more types of equipment in more markets than any other engine company



Common Requirements	
Fuel Efficient	Low Cost
High Power Density	Quick Start
Transient Operation	Durability

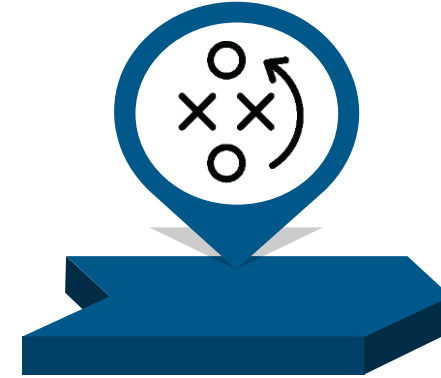
Disruptive Trends



New technologies



Regulations



Competition



Emissions



Energy prices
& availability



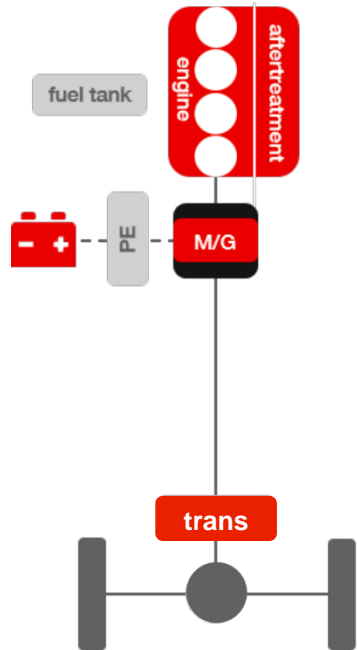
Globalization



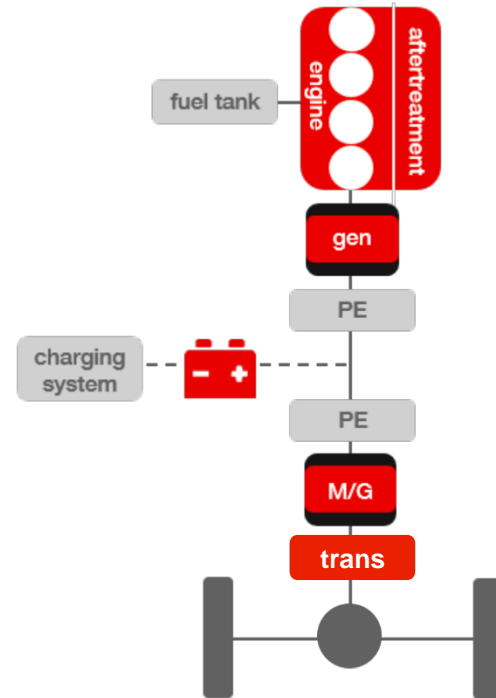
Infrastructure

“Power of Choice” – Fuel Cell fit to Cummins applications

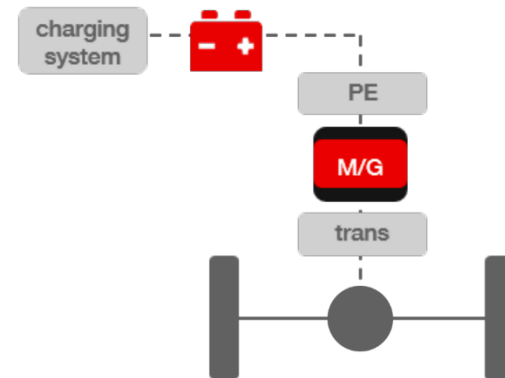
INTERNAL COMBUSTION ENGINE



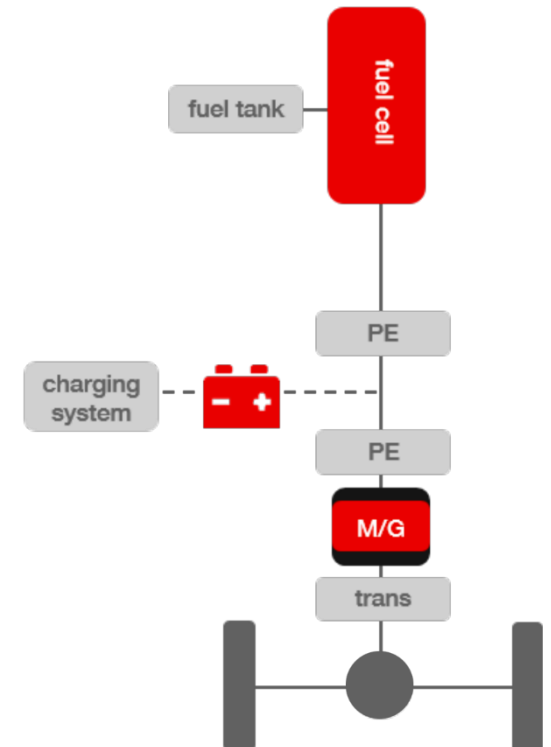
HYBRID



BATTERY ELECTRIC



FUEL CELL ELECTRIC

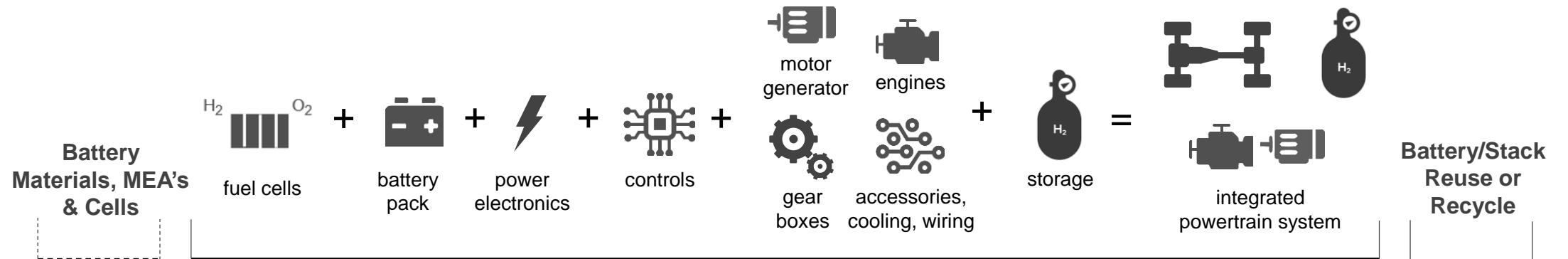
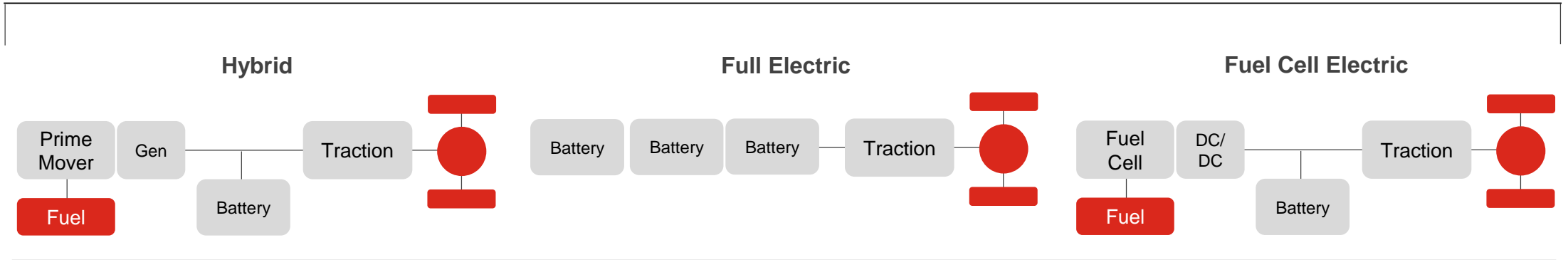


Cummins turnkey electrified systems

Product and technology strategy

SERVICE & SUPPORT

SYSTEM OFFERINGS



COMPONENTS

CHARGING , CONNECTIVITY, HYDROGEN GENERATION & SUPPLY

PEMFC vs. SOFC

Proton Exchange Membrane (PEM)

Solid Oxide Fuel Cells (SOFC)

Pure H ₂	H ₂ , CNG, LNG, Diesel, Gasoline, Ethanol, Methanol, Biofuels
Efficiency: 45-60%	Efficiency: 45-65% (80+ in CHP)
Temperature: 65-90°C	Temperature: 600-900°C
Emissions: Zero Emissions	Emissions: NOx < 1ppm, CO <100ppm, CO ₂ *
Instantaneous Startup & Transient Response	Long Startup Time & Slow Transients
Lower Initial Cost (\$1000/kW → \$50/kW)	Higher Initial Cost (\$4000/kW → \$1000/kW)
High fuel cost (\$10/kg)	Very low fuel cost (NG: 2 cents/kWh)
Water Management, Humidification, Pressure Levels, H ₂ storage & availability	Start-up, Brittle Ceramics, Oxidation of Anode



Active exploration in PEMFC & SOFC

STATIONARY POWER – SOFC

- Higher sensitivity to operating cost
 - Efficiency
 - Fuel cost – natural gas preferred
- Data centers offer a large potential initial market

ON-HIGHWAY POWER – PEM OR SOFC

- Higher sensitivity to initial investment
- Requires distributed fuel availability
- Sensitive to fuel price, but not as much as stationary power
- Regulations (zero carbon zones) & subsidies are the key drivers



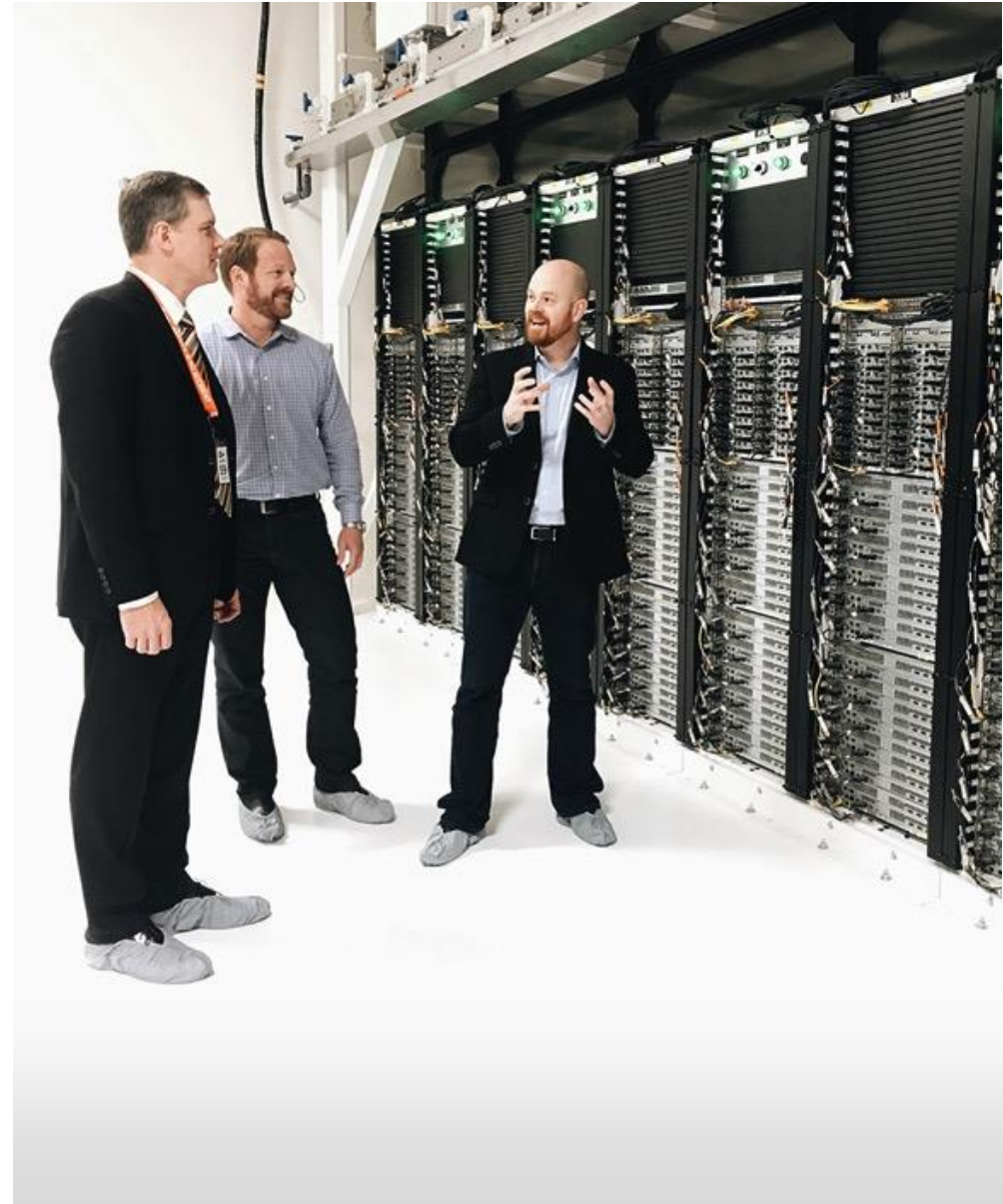
COSTA RICA H2 TRANSPORTATION ECOSYSTEM PROJECT

The project's objective is to establish a public transport demonstration ecosystem in Costa Rica based on H2 generated from carbon-free, renewable energy and to measure its financial sustainability, business potential and its relevance to Costa Rica and the region. The first phase focused on demonstrating technical viability and the second phase will focus on demonstrating financial sustainability.



MICROSOFT- CUMMINS ADVANCED ENERGY LAB

The lab's initial focus will be on powering datacenters with natural gas powered fuel cells. The 20-rack environment in the lab simulates datacenter conditions to evaluate whether the fuel cells have the potential to improve efficiency, reduce emissions and cut costs.



Four Keys to Adoption

- Efficiency
- Durability/life
- Cold start
- Transient response



Technology



Regulations

- Zero emission zones
- Government funding
- Incentives

- Public refueling stations
- Pipeline
- Hydrogen by-product from industries



Infrastructure Readiness



Total Cost of Ownership

- Technology cost (\$/kW)
- Fuel cost (\$/kg)
- On-board storage system
- Refueling station cost



Cummins acquiring Hydrogenics



TECHNOLOGY

Adds both fuel cell and hydrogen generation equipment enabling Cummins to offer a full differentiated solution, from start to finish, seamlessly integrated for customers.



EXPERTISE

Adds a proven team with deep expertise and experience in fuel cell technology to Cummins.



SPEED TO MARKET

Hydrogenics' long-track record of commercial success in a technology that is beginning to accelerate provides a springboard for Cummins into fuel cell markets, particularly in China and Europe.



COLLABORATION

Global gas leader Air Liquide will continue to be a minority investor, offering collaboration opportunities to strategically address the production of hydrogen, which has been a long-standing barrier to broad fuel cell adoption.

The acquisition remains subject to regulatory and shareholder approvals.

OUR ELECTRIFICATION VISION

We will be a leader in
electrified power in all the
markets we serve.

