

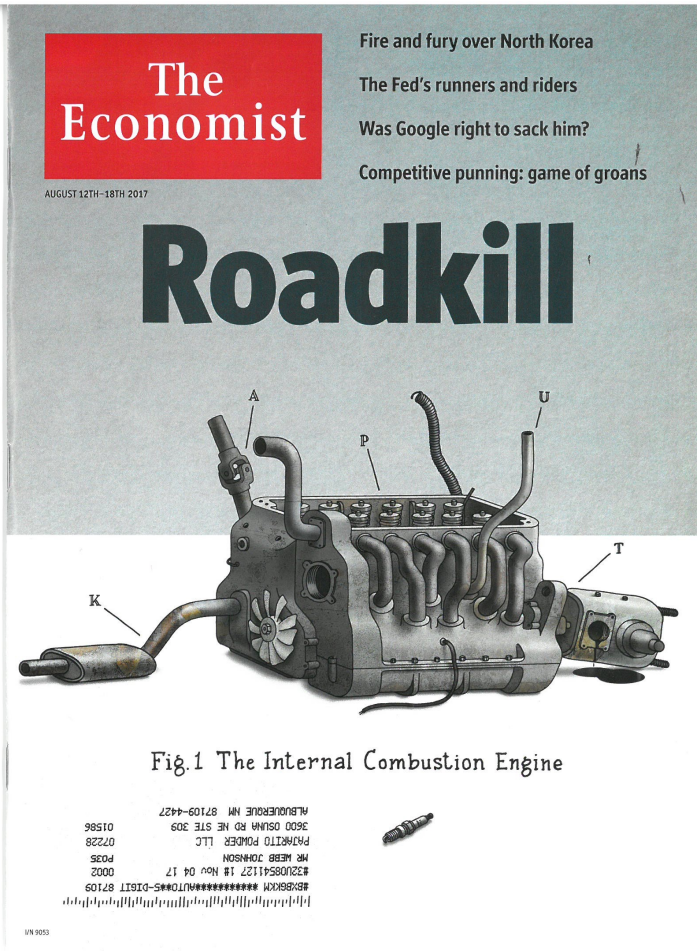
**PAJARITO
POWDER**

FUEL CELL CATALYSTS

**Advanced catalyst materials
for electric mobility.**

NREL Innovation Showcase 2018

The Era of Internal Combustion is Over

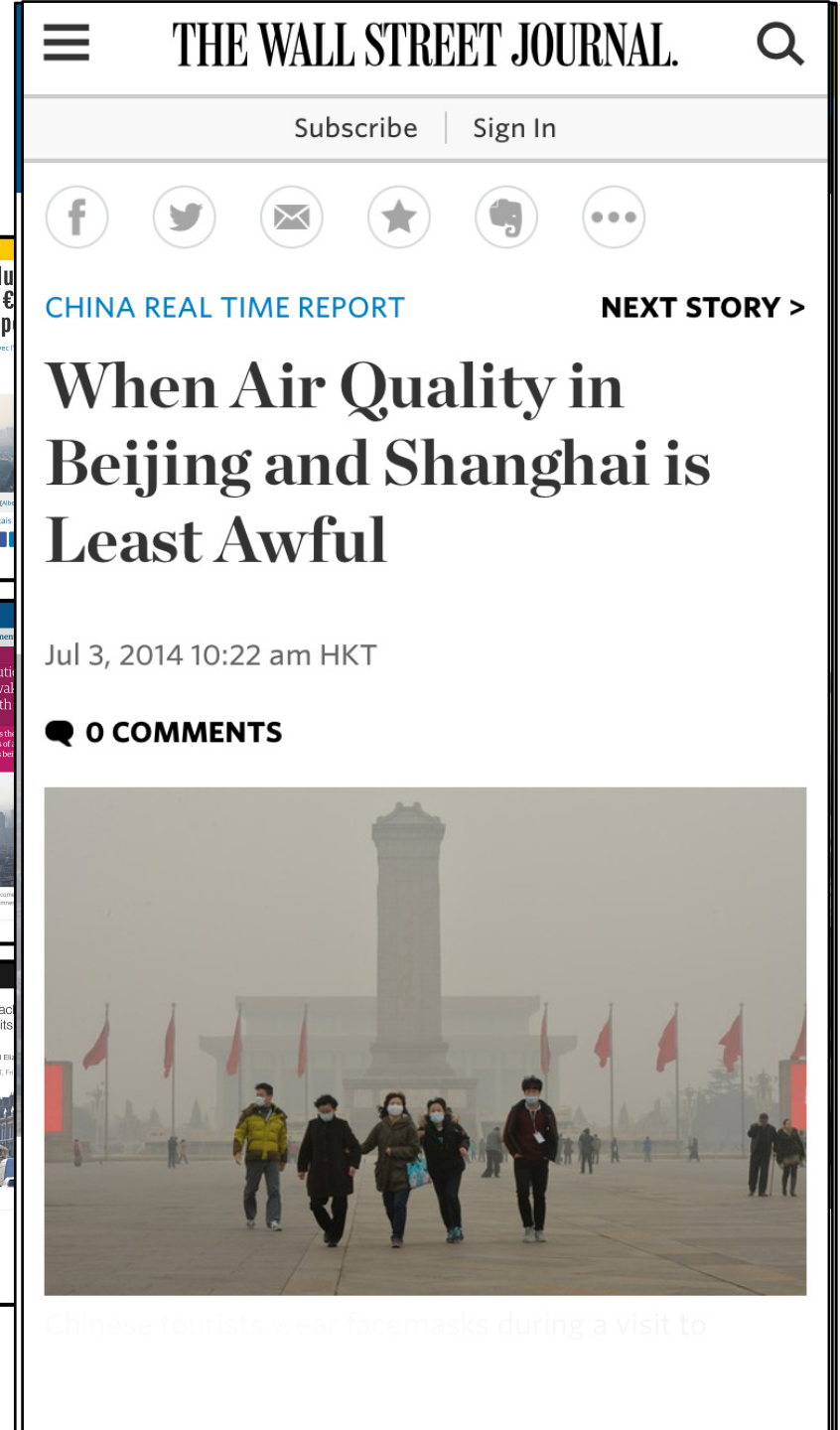


- World is moving to electric propulsion
- Goal is conceivable
- Technology requires more work
- Not driven by climate change

Pollution Is Driving Change

- Air quality in major cities
- Transportation air pollution constitutes a world health crisis
- Bans on internal combustion
- Automotive industry is reacting

Pajarito Powder, LLC



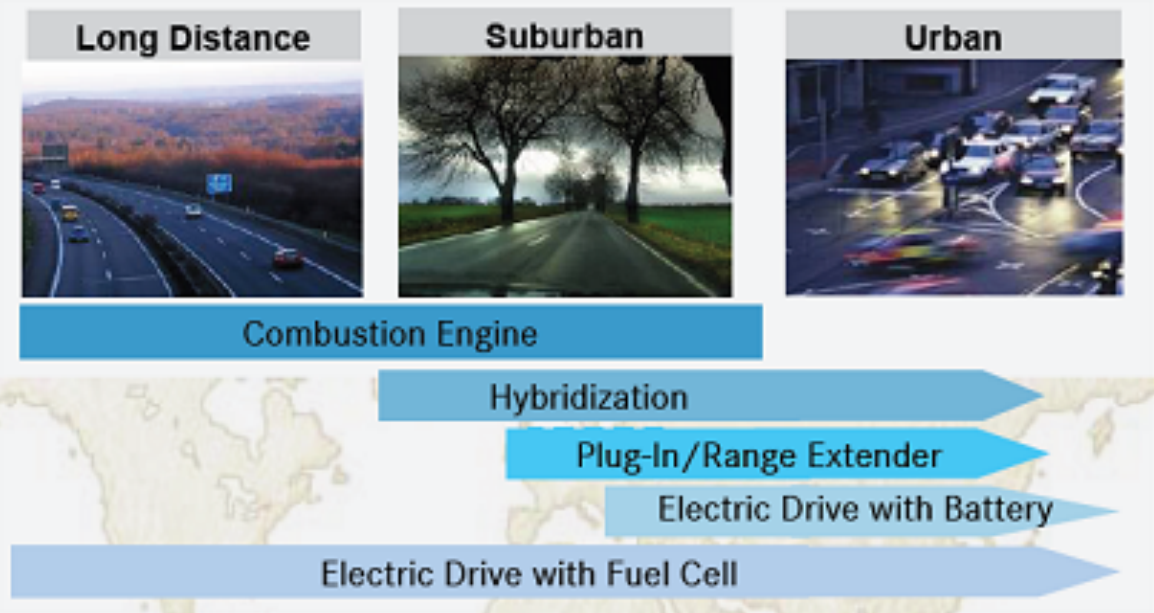
Major Automotive OEMS Have A Plan

- Different electric drivetrains for:
 - Different drive and duty cycles
 - Ranging from light load, stop & go cycle BEV
 - to heavy load, continuous drive cycle FCEV

Major Automotive OEMS Have A Plan

DAIMLER

Drivetrains for Various Driving Cycles



➤ Only fuel cell technology is suited equally for both, short and long distance mobility

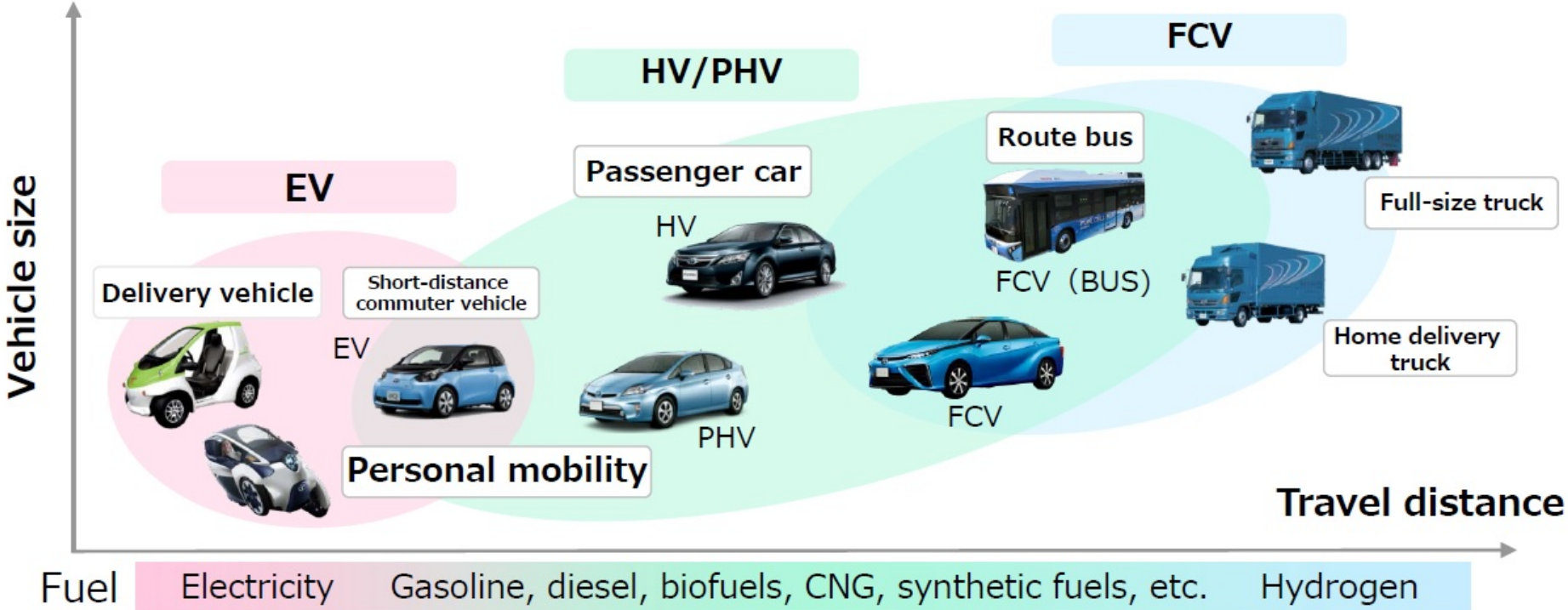
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Major Automotive OEMs Have A Plan

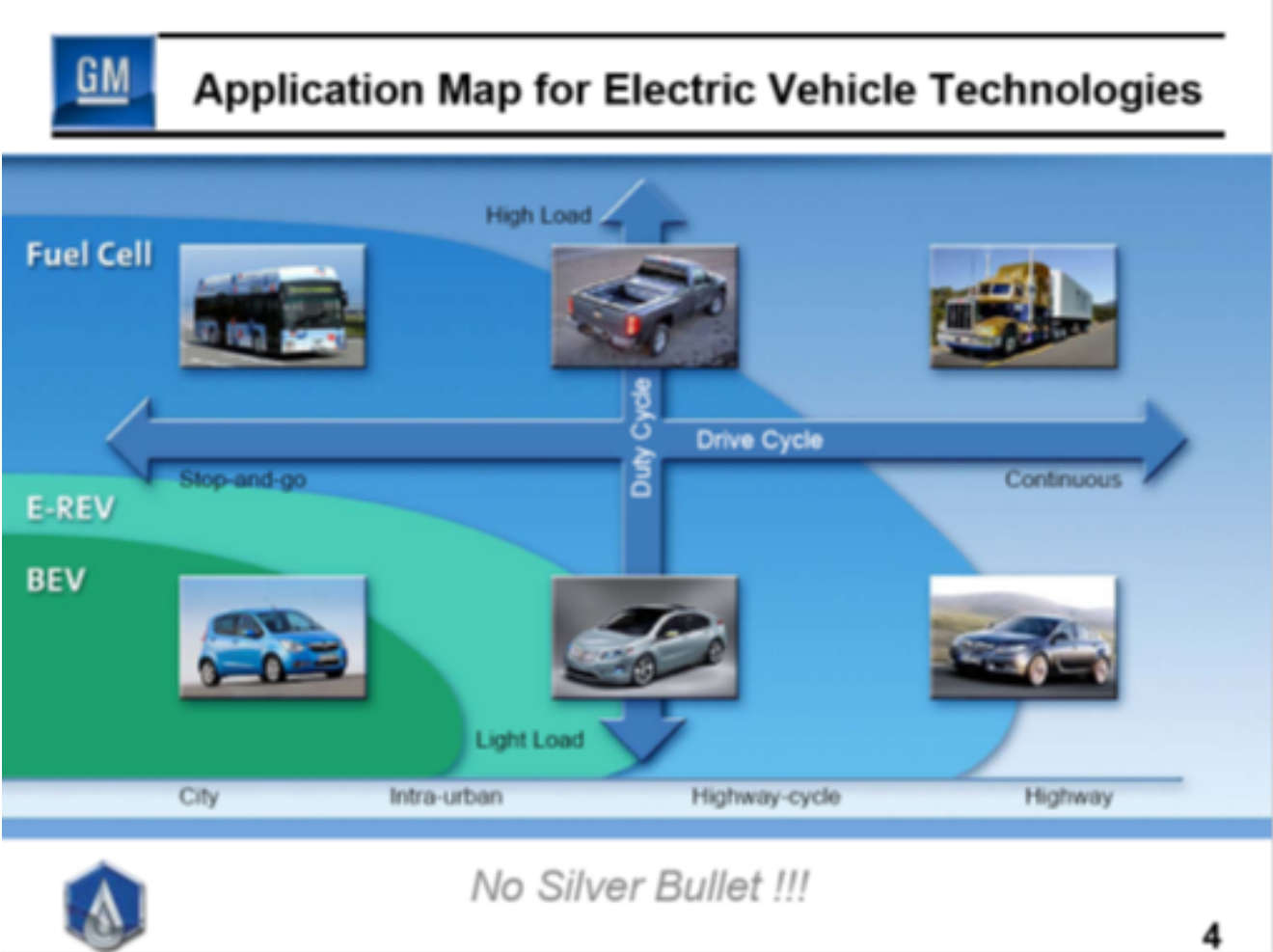
Fuel diversity and uses

TOYOTA



EV: Short-distance, HV & PHV: Wide-use, FCV: Medium-to-long distance

Major Automotive OEMS Have A Plan





KPMG's 19th consecutive

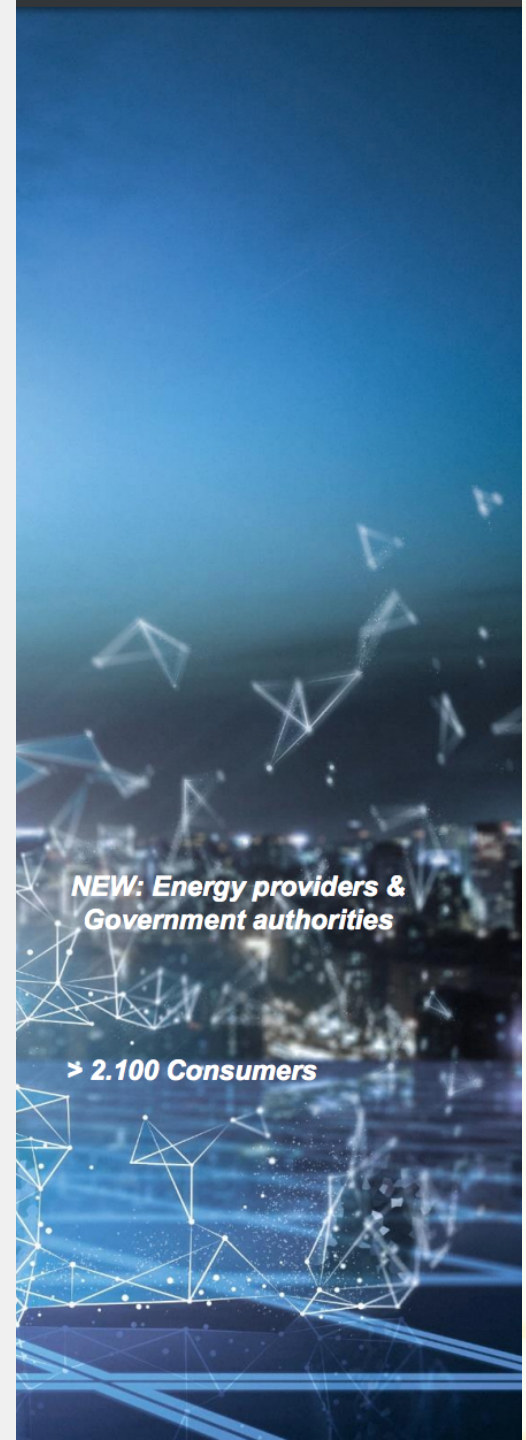
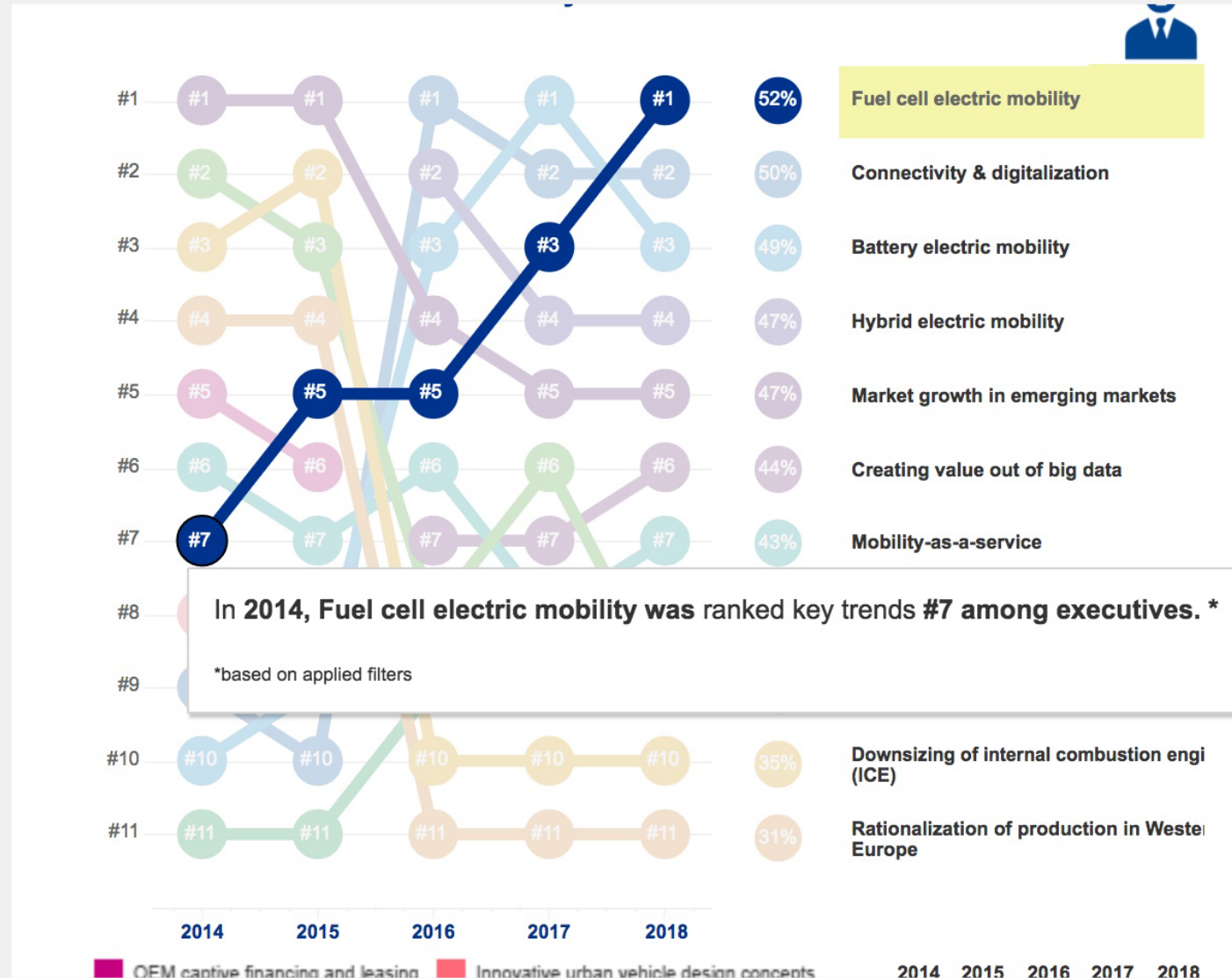
Global Automotive Executive Survey 2018

There is a next in every industry –
a next generation of products,
services and content.

See it sooner with KPMG.

www.kpmg.com/GAES2018 | Press conference, January 5th 2018





NEW: Energy providers & Government authorities

> 2.100 Consumers

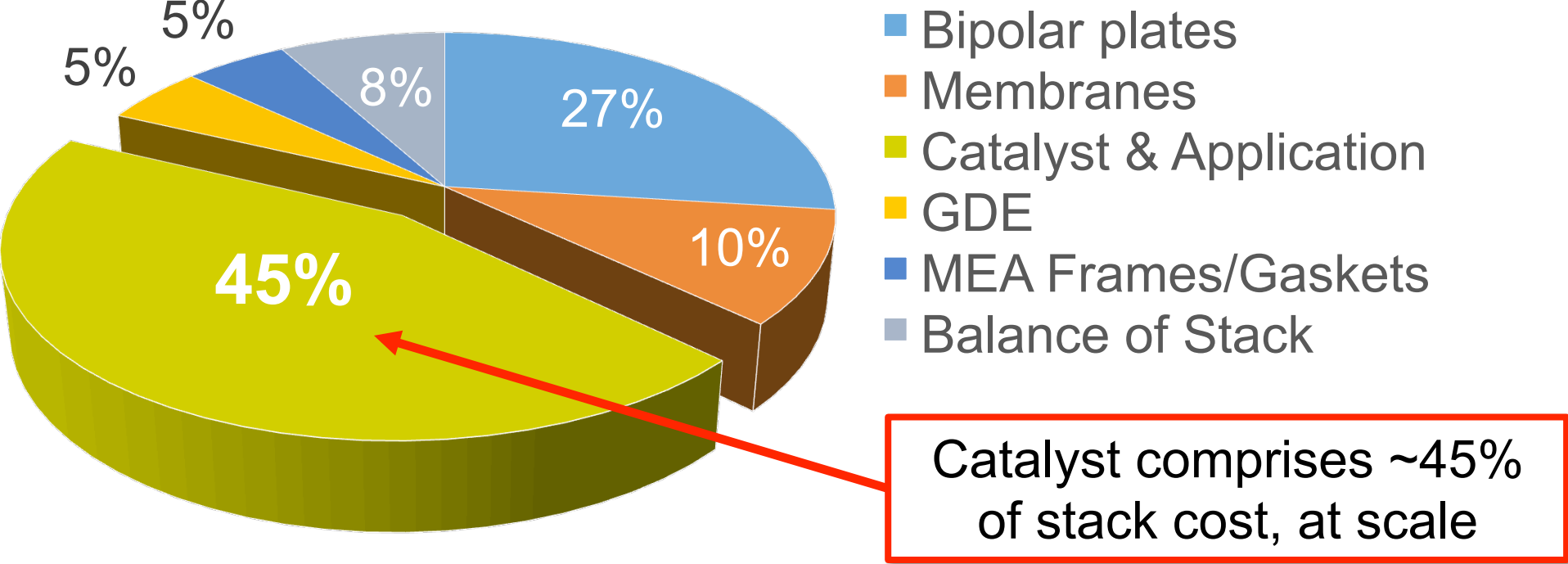
FCEV Offerings



	Toyota Mirai	Honda Clarity FC	Hyundai Nexo
Fuel Cell system	114 kW PEM	est. 110 kW PEM	95 kW PEM
Battery System	1.6 kWh NiMH	1.7 kWh Lithium-ion	1.5 kWh Lithium-Ion
Electric Motor	113 kW / 335 Nm	103 kW / 300 Nm	120 kW / 395 Nm
Range in miles / km	312 miles / 502 km	366 miles / 589 km	370 miles / 595 km
H2 Tank	5 kg H @ 70 MPa	5.46 kg H @ 70 MPa	6.3 kg H @ 70 MPa
Est price / Lease price	\$60,000 / \$349 monthly	\$58,490 / \$369 monthly	\$55,000 est.
Wheelbase / Weight	109" / 4,078 lbs	108" / 4,134 lbs	109" / 5,158 lbs

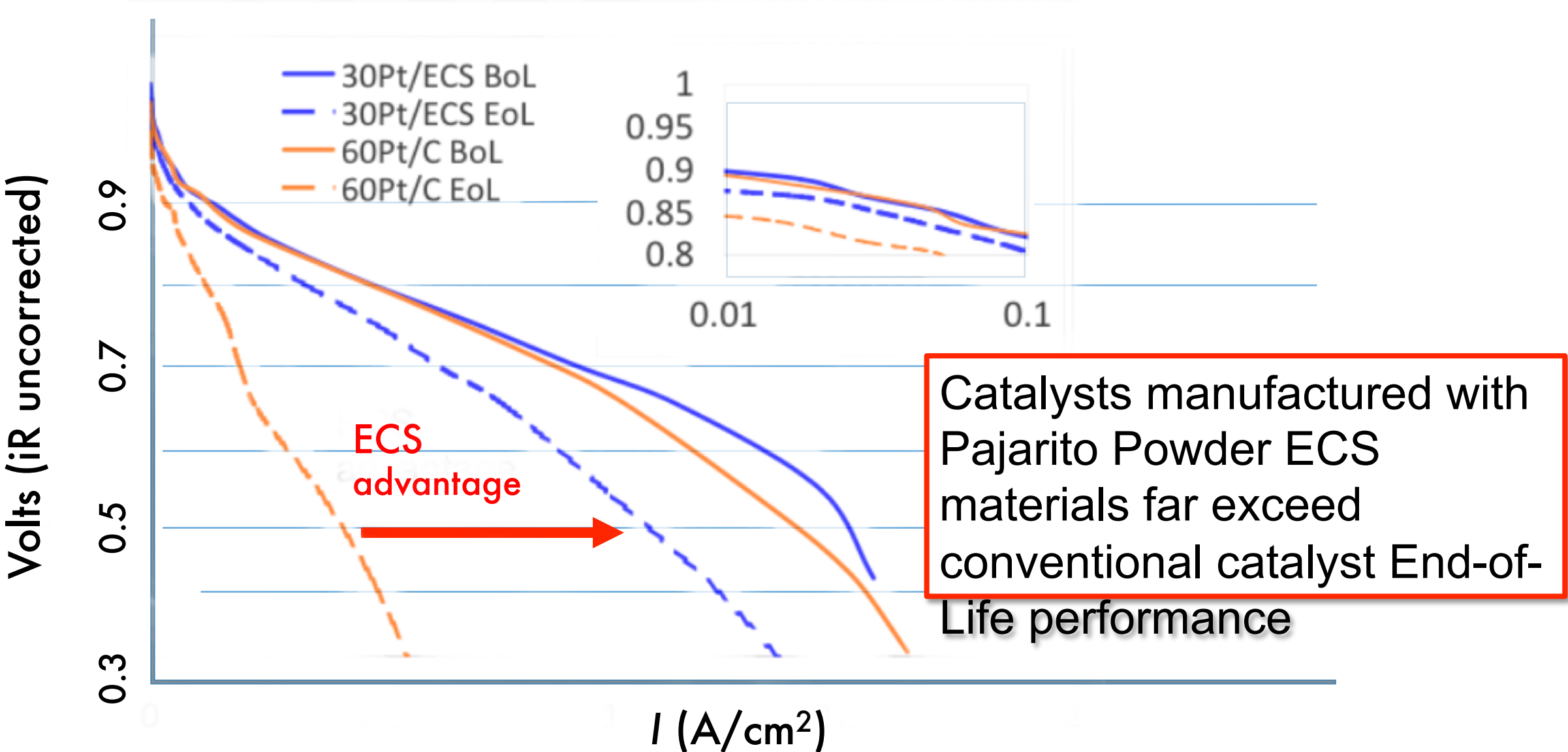
Catalyst Cost

Stack Component Costs



DOE Hydrogen and Fuel Cells Program Record #: 15015 Fuel Cell System Cost – 2015. Expected Volume 500,000 units annually

Catalyst Performance

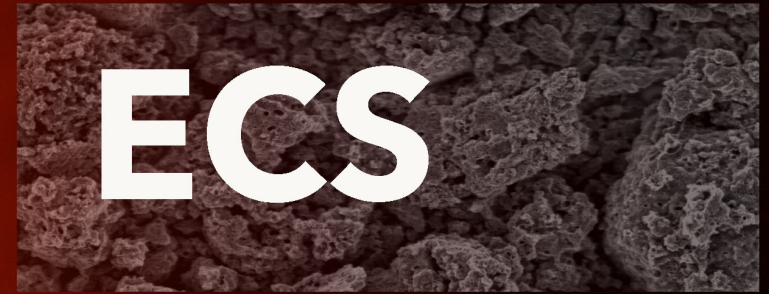
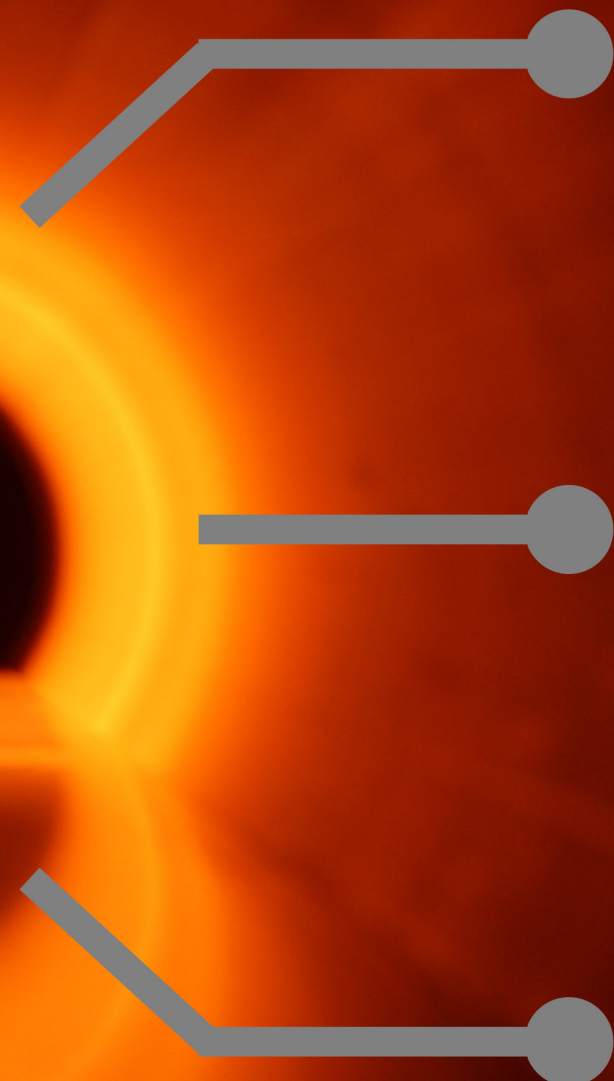
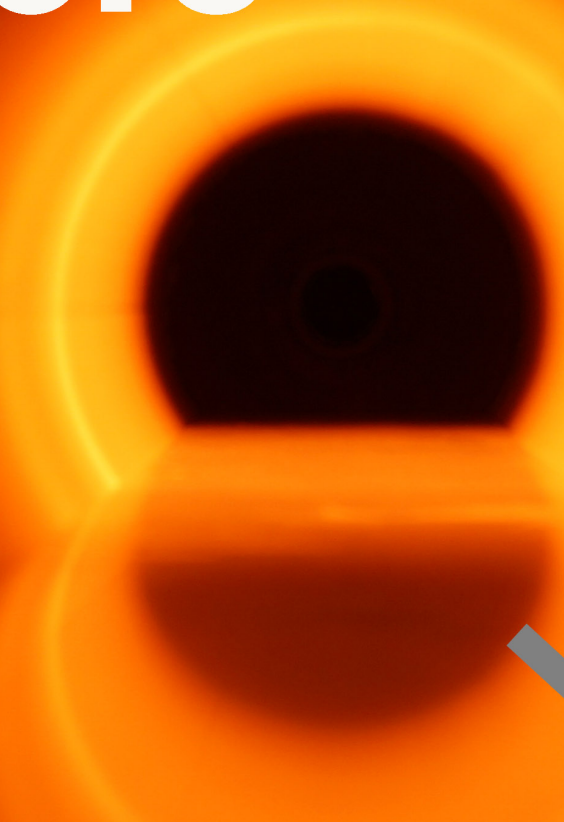


Pajarito Powder

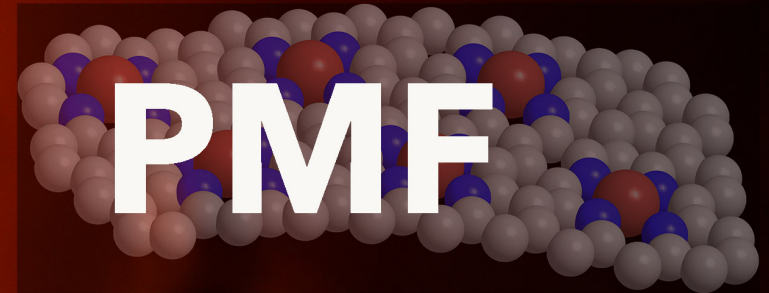
- Developer and Manufacturer of Fuel Cell Catalysts and Catalyst Supports
- Proprietary, patented manufacturing platform
- Intellectual Property portfolio with 40 patents
- World-class technical team & advisory board
- Strong customer engagement



VariPore™



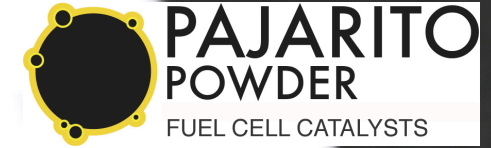
ECS



PMF

**Electrolyzer
Catalysts**

VariPore Platform: Products



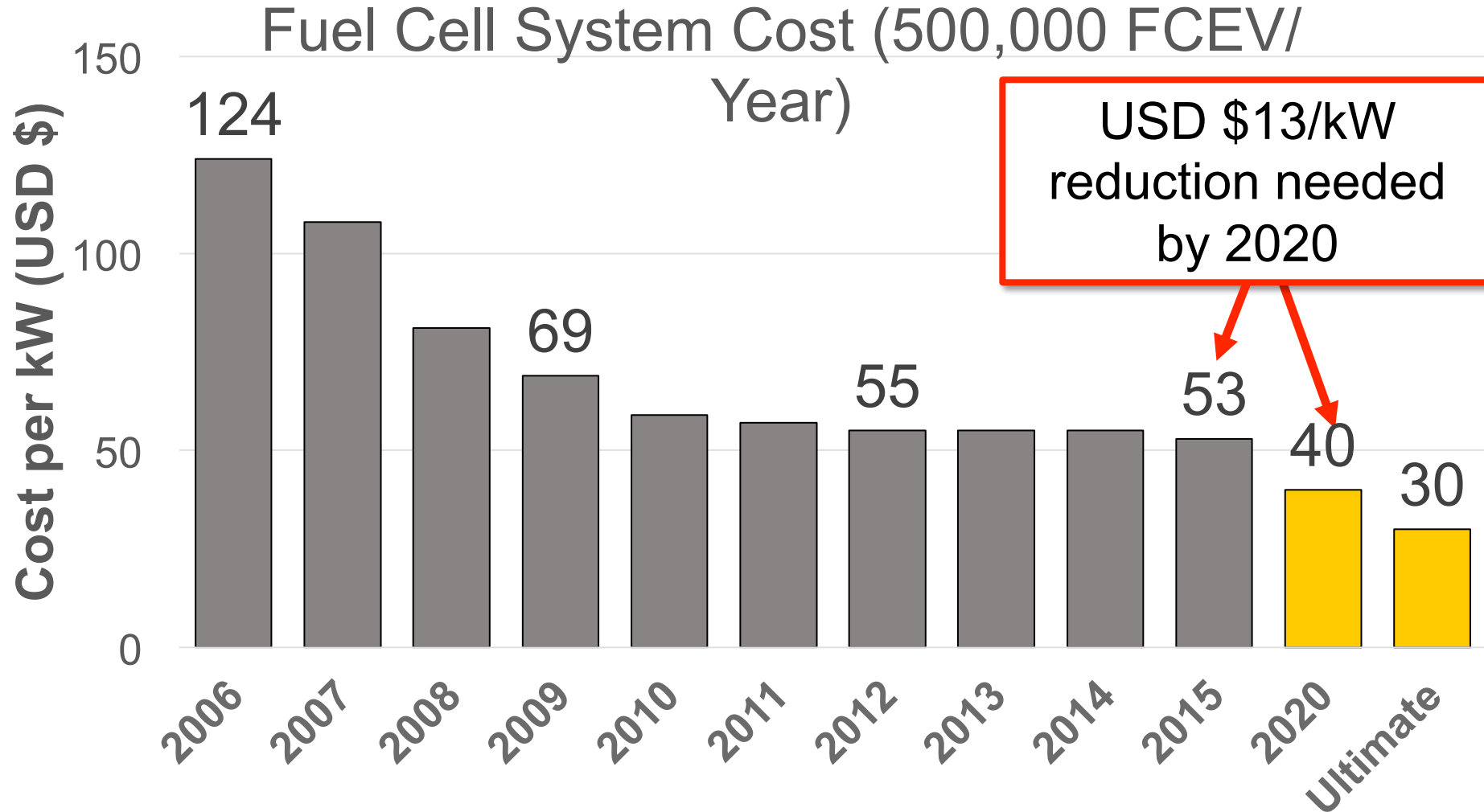
- Fuel Cell Catalyst Supports™ (ECS)
- Platinum on ECS Catalysts
- Precious-Metal-Free (PMF) Catalysts
- Electrolyzer Catalysts
 - Carbon-free in development

Competition & Market



- Existing solutions use commodity carbons designed for tires
- “Engineered Catalyst Supports” crucial for durability and overall performance
- Incumbents do not service the market
- \$500 million in catalyst at scale

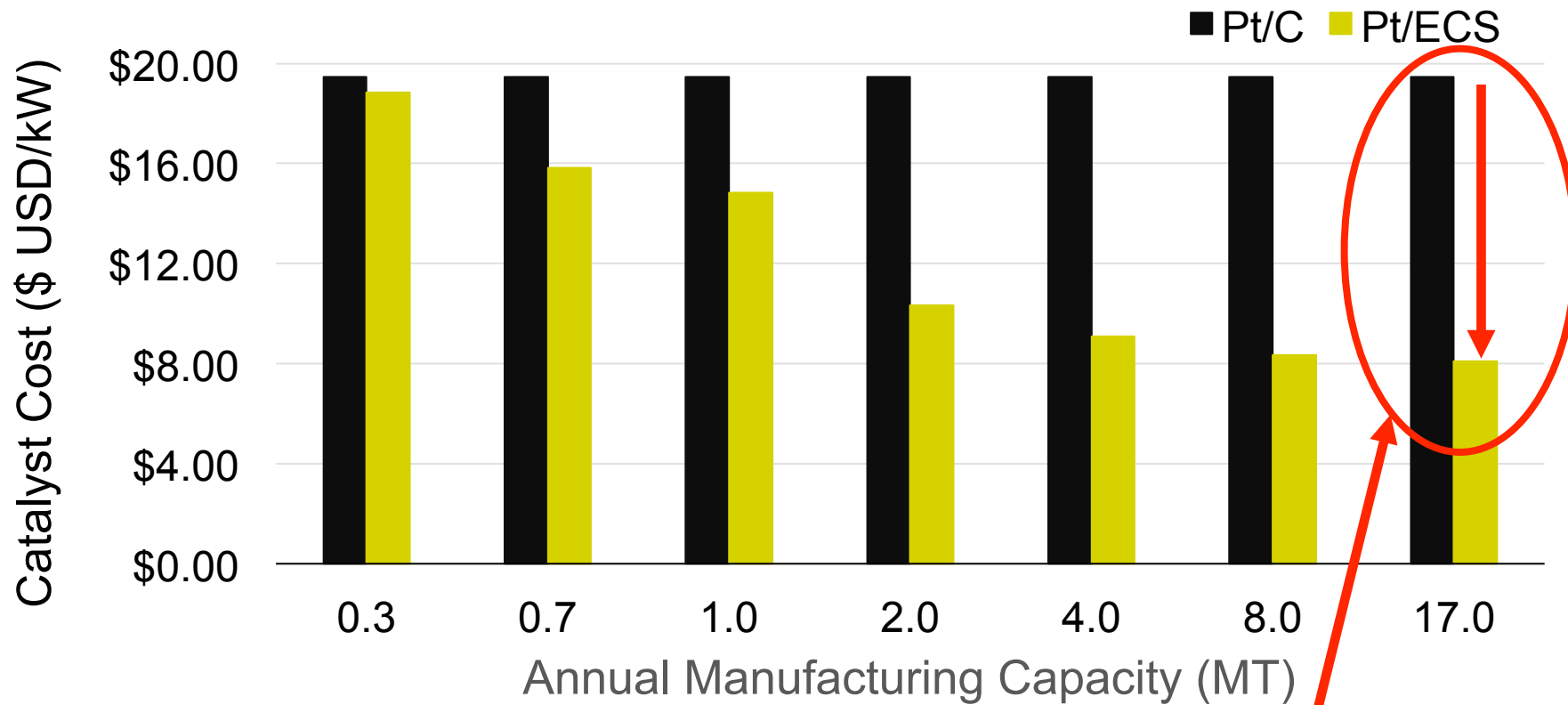
Fuel Cell Cost Challenge



DOE Hydrogen and Fuel Cells Program Record #: 15015 Fuel Cell System Cost - 2015

Pajarito Closes the Gap

Commercial Catalyst versus Pajarito Catalyst

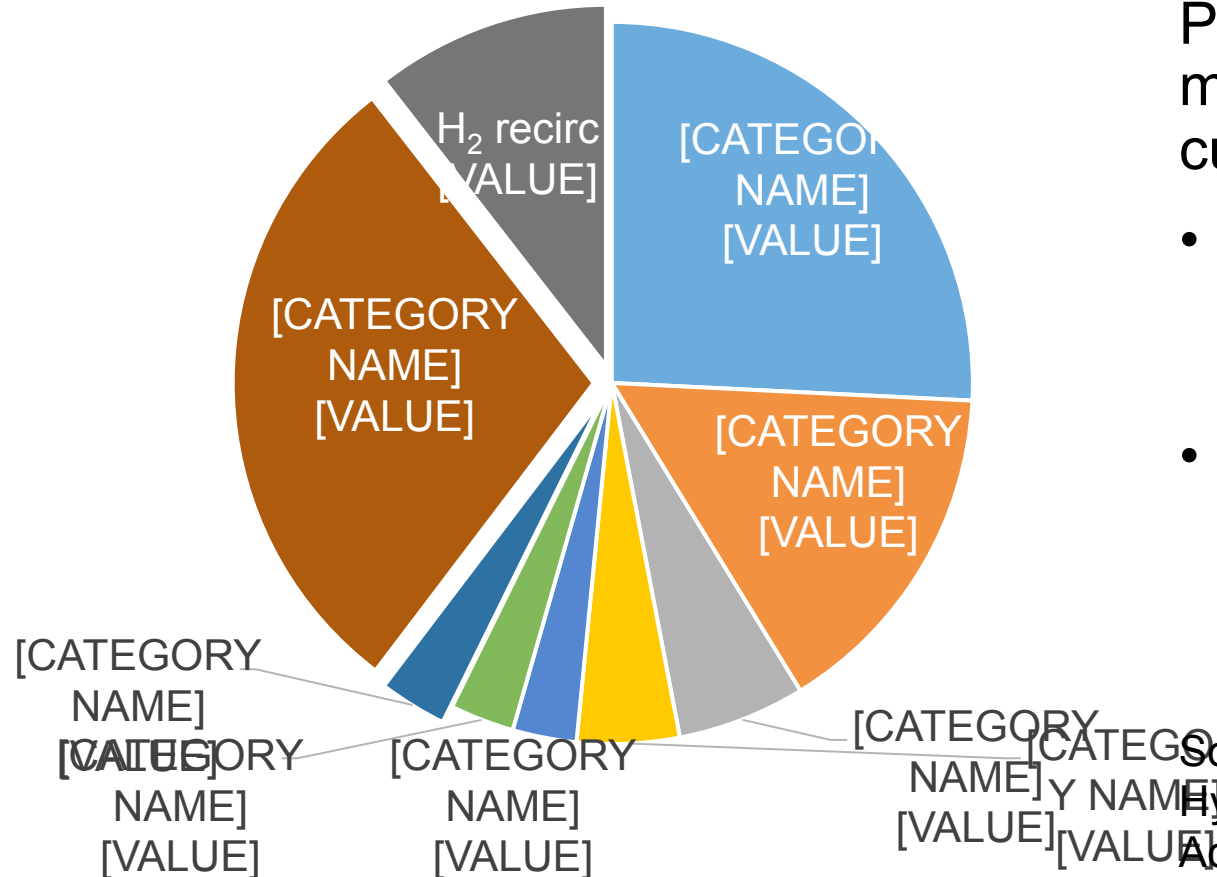


Pt/C calculations from: DOE Hydrogen and Fuel Cells Program Record #: 15015 Fuel Cell System Cost - 2015

Pajarito products reduce catalyst cost by more than USD \$10/kW at scale

Systems Cost Savings Potential

System Cost: Stack (66%) and BOP (44%) proportional cost breakdown

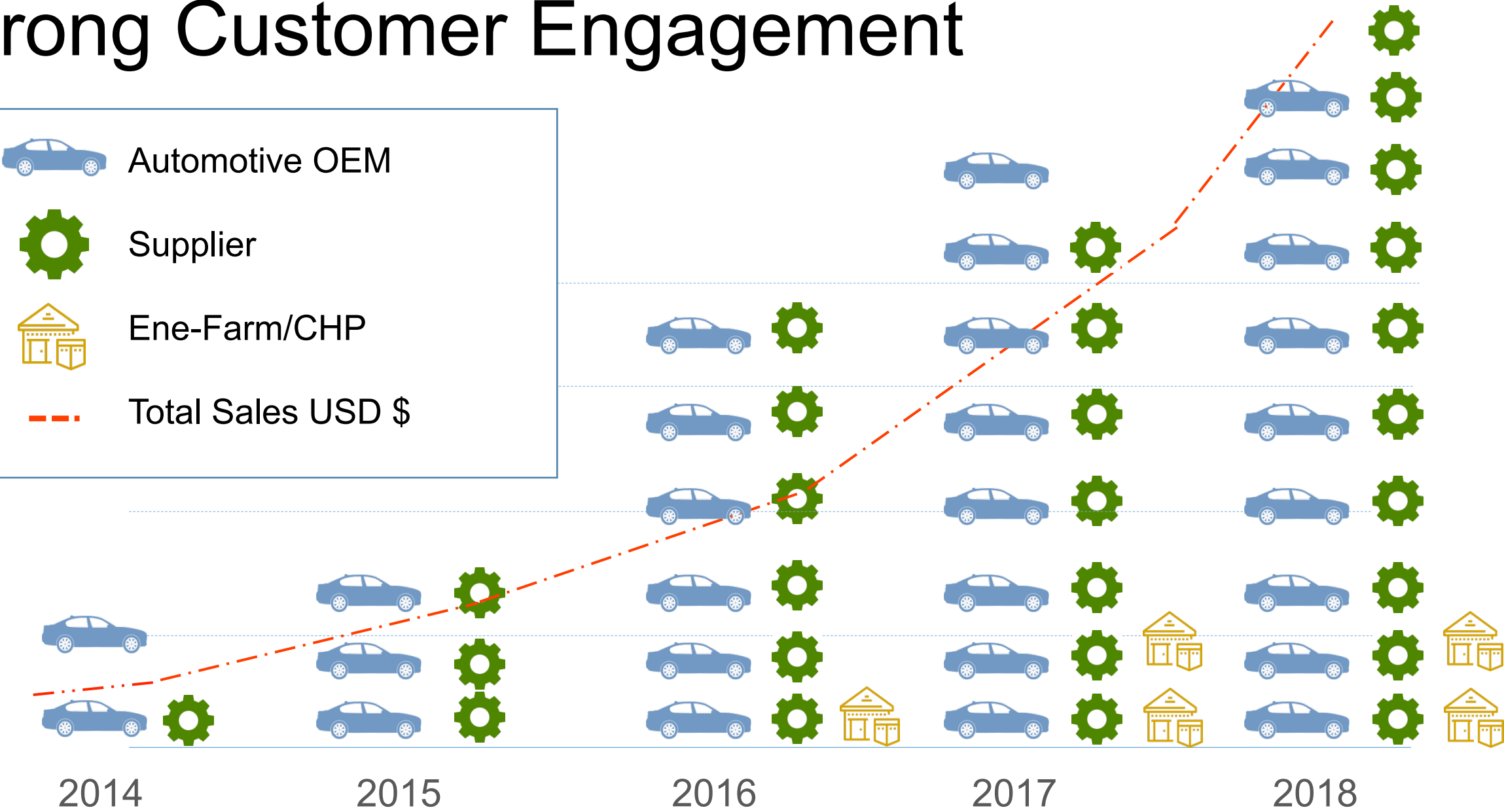
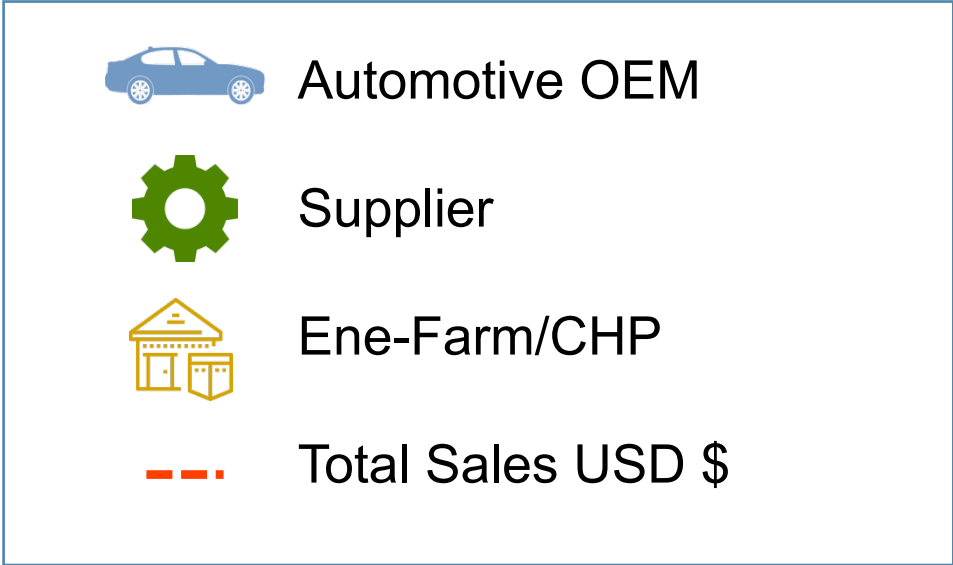


Pajarito Powder materials provide materials solution cost-savings over current systems-solution-orientation:

- Superhydrophobic supports eliminate need for humidification (~\$100+/car) and reduce air loop needs
- Corrosion resistant support eliminate current/voltage monitoring and anode purge system (\$600-\$1,200+/car)

Source: Fuel Cell System Cost – 2017, DOE Hydrogen and Fuel Cells Program Record #17007, Adria Wilson, Gregory Kleen, and Dimitrios Papageorgopoulos

Strong Customer Engagement

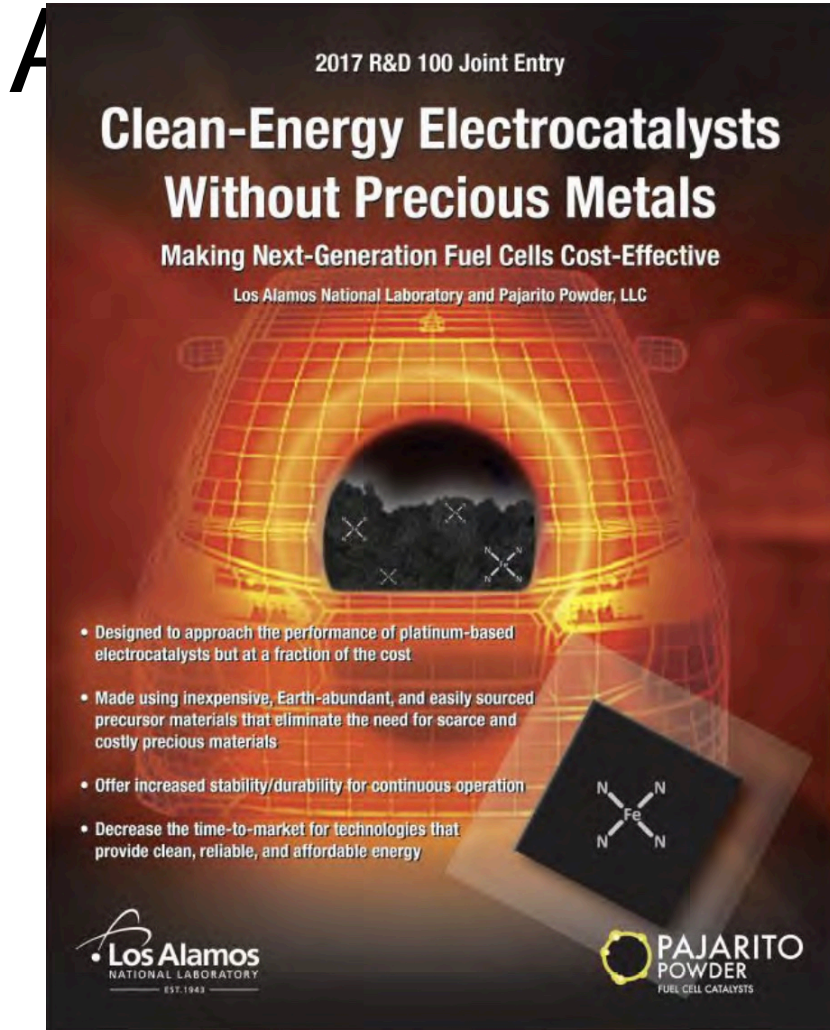


R&D 100 Award In Conjunction with Los

2017 R&D 100 Joint Entry

Clean-Energy Electrocatalysts Without Precious Metals

Making Next-Generation Fuel Cells Cost-Effective
Los Alamos National Laboratory and Pajarito Powder, LLC



- Designed to approach the performance of platinum-based electrocatalysts but at a fraction of the cost
- Made using inexpensive, Earth-abundant, and easily sourced precursor materials that eliminate the need for scarce and costly precious materials
- Offer increased stability/durability for continuous operation
- Decrease the time-to-market for technologies that provide clean, reliable, and affordable energy

Los Alamos NATIONAL LABORATORY EST. 1943

PAJARITO POWDER FUEL CELL CATALYSTS

- 2017 R&D100 Award for joint entry between LANL and Pajarito Powder
- Materials category for “Precious-Metal-Free Electrocatalysts”

R&D 100 Award In Conjunction with Los



- 2017 R&D100 Award for joint entry between LANL and Pajarito Powder
- Materials category for “Precious-Metal-Free Electrocatalysts”

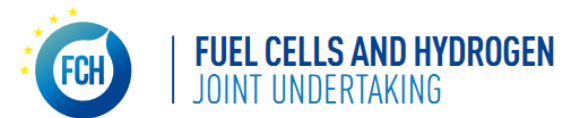
Substantial Non-Dilutive Funding

U.S. Department of Energy	
	ARPA-E
<i>EERE – Fuel Cell Technology Office</i>	
	FCTO PGM-Free
	Incubator Program
	Small Business Innovation Research
	Small Business Vouchers
	ElectroCat (Award Negotiation)
	ElectroCat (Sub-contract)
New Mexico Economic Development Department	
	STEP Program
	SBIR Matching Grant



U.S. DEPARTMENT OF
ENERGY

Energy Efficiency &
Renewable Energy



Intellectual Property

7,678,728 (US), 9,425,464 (US) 2013290185 (Aus)
8,252,711 (US) 9,570,761 (US)

- World-wide protection
- Licensed from
 - Los Alamos National Laboratory (LANL)
 - The University of New Mexico (UNM)
 - Institut National de la Recherche Scientifique
- Native “know-how” and trade secrets

The Team



**Thomas J.
Stephenson**

**CEO &
Chairman**



**Dr. Barr
Zulevi**

**CTO &
President**



**Dr. Alia
Lubers**

**Chief
Engineer**



**Dr. Alexey
Serov**

**Chief
Scientist**



**Webb
Johnson**

**Senior Director
of Business
Dev.**



**Dr. Saburo
Hori**

**Director of
Asia Business
Dev.**



**Dr. J. Byron
McCormick**

Board Member

Technical Advisory Board



**Dr. Piotr
Zelenay
(Chair)**

**Los Alamos
National
Laboratory**



**Professor
Plamen
Atanassov**

**University of
New Mexico**



**Professor
Scott
Calabrese
Barton**

**Michigan State
University**



**Professor
Jean-Pol
Dodelet**

**Institut
National de la
Recherche
Scientifique**



**Professor Dr.
Hubert
Gasteiger**

**Technical
University of
Munich**



**Professor
Sanjeev
Mukerjee**

**Northeastern
University**

Conclusion and next steps

- If you are interested in chatting about what is happening next for Pajarito Powder, please see me after this presentation
- If you are connected with Tier 1 automotive suppliers, please come see me
- Questions?

PajaritoPowder.com

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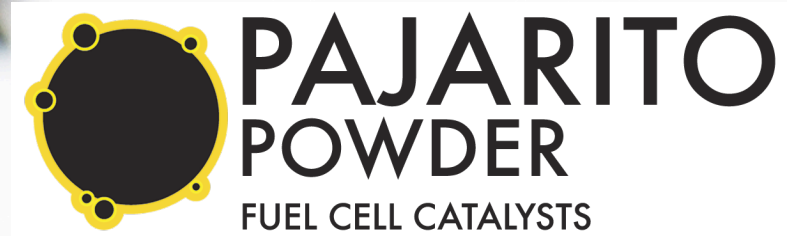
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Forklifts & Materials Handling

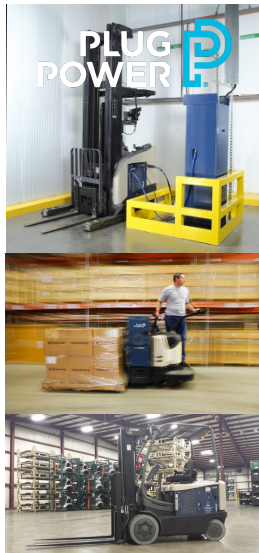


Combined Heat & Power



Panasonic

VIESMANN



Stationary Power

