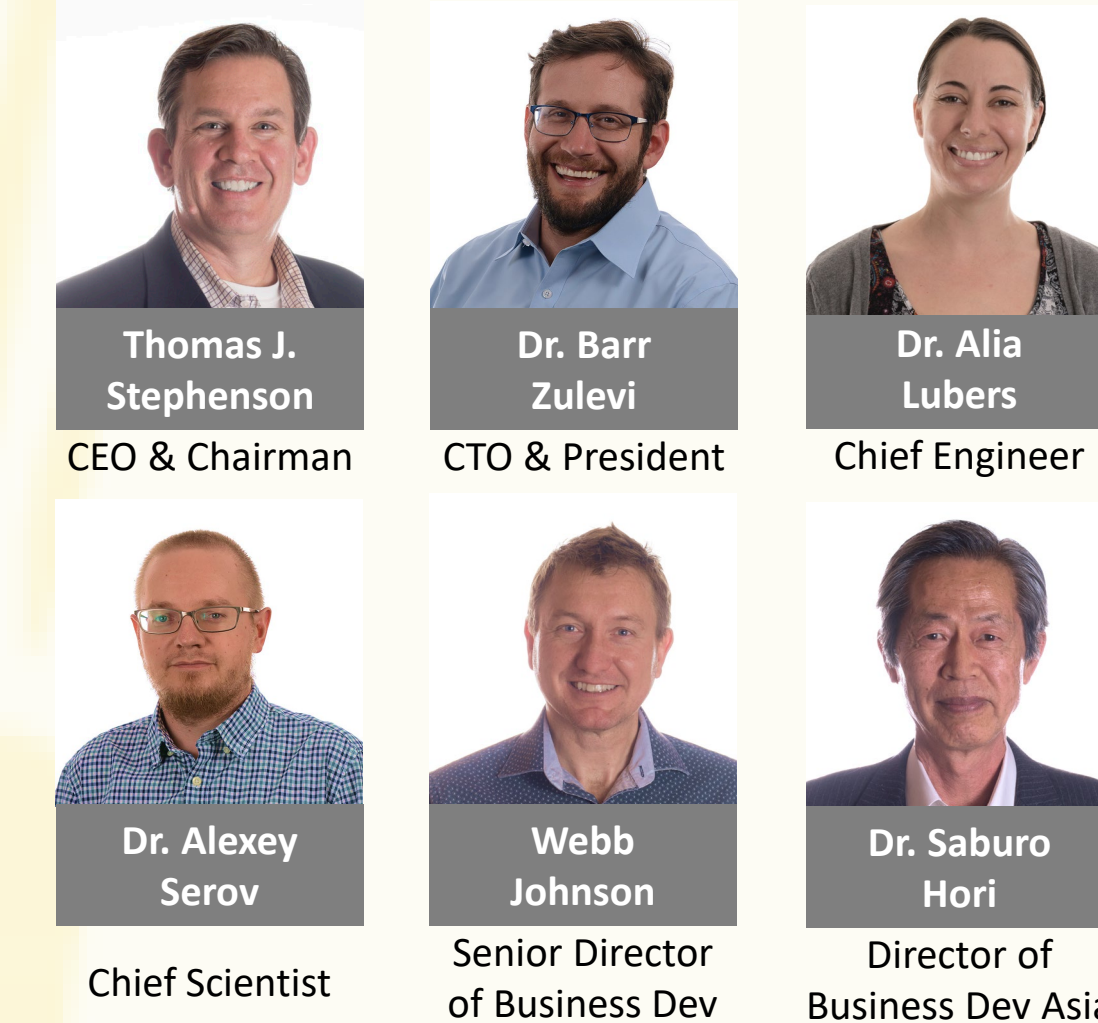


Pajarito Powder, LLC: The Team, Customer Engagement & Why We Exist

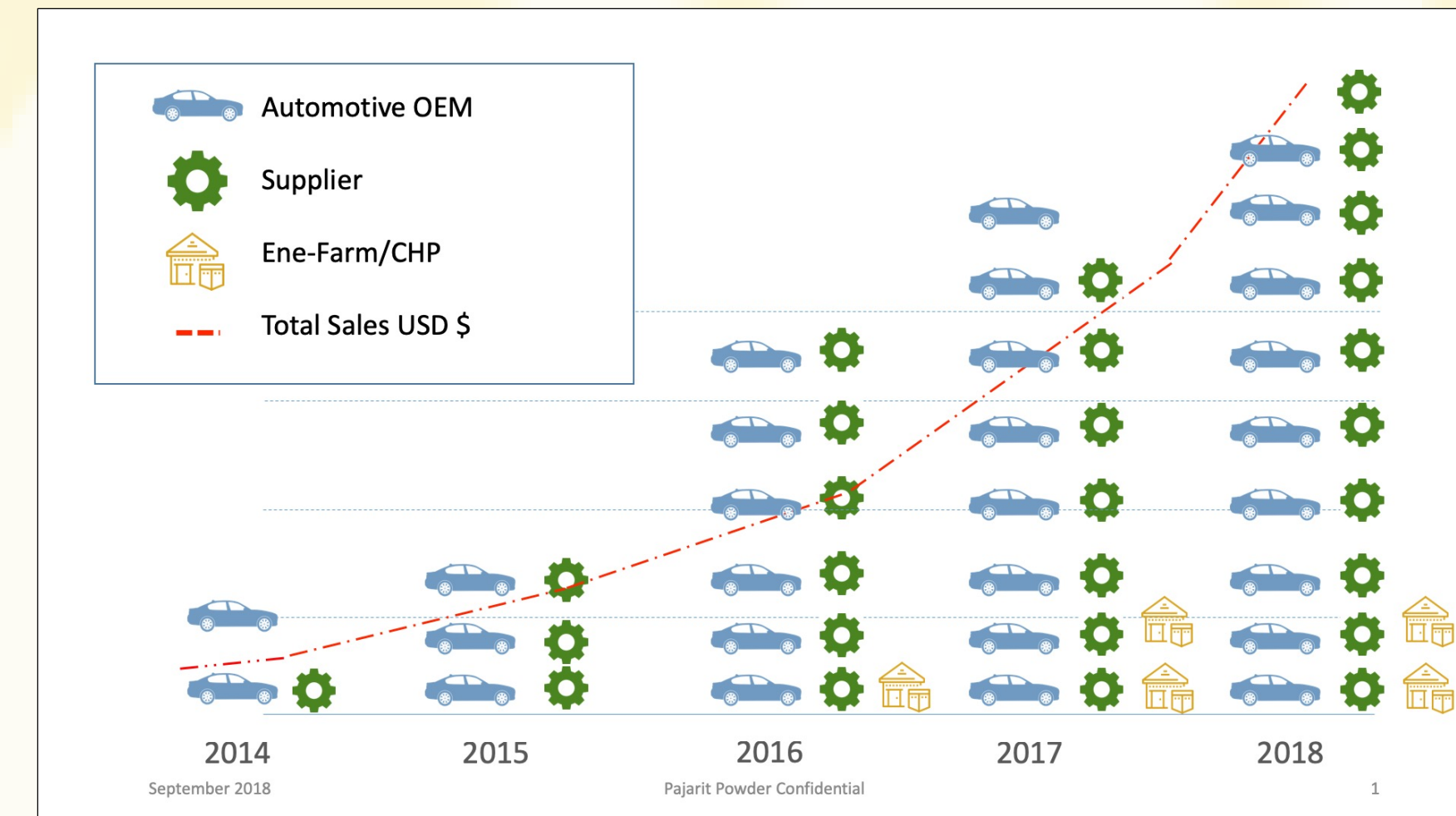
The Team



Products

- Fuel Cell and Electrolyzer catalysts
- Catalyst is the single most expensive component in a fuel cell stack (30%+ of total stack cost)
- Pajarito Powder products achieve 60% of needed cost reduction (~10\$/kW savings)
- Current Products
 - Engineered Catalyst Support (ECS)
 - Pt/ECS Catalysts
 - Precious-Metal-Free (PMF) Catalysts
 - Electrolyzer Catalysts (In Development)

Strong Customer Engagement



Pajarito Powder Differentiation

- Customer-focused / Customer-responsive
- "Right-scale" development and manufacturing
- Proprietary modular and flexible VariPore™ manufacturing platform
- Concentration on the lower-cost, historically under-engineered catalyst component, not the expensive precious-metal commodity
- Combination of international patents, trade-secrets and know-how

Precious Metal Free Regenerative Hydrogen Electrode ARPA-E DE-AR0000688

Lead Personnel

Barr Zulevi
Pajarito Powder
Kathy Ayers
Proton Onsite
Sanjeev Mukerjee
Northeastern University
Madeleine Odgaard
IRD

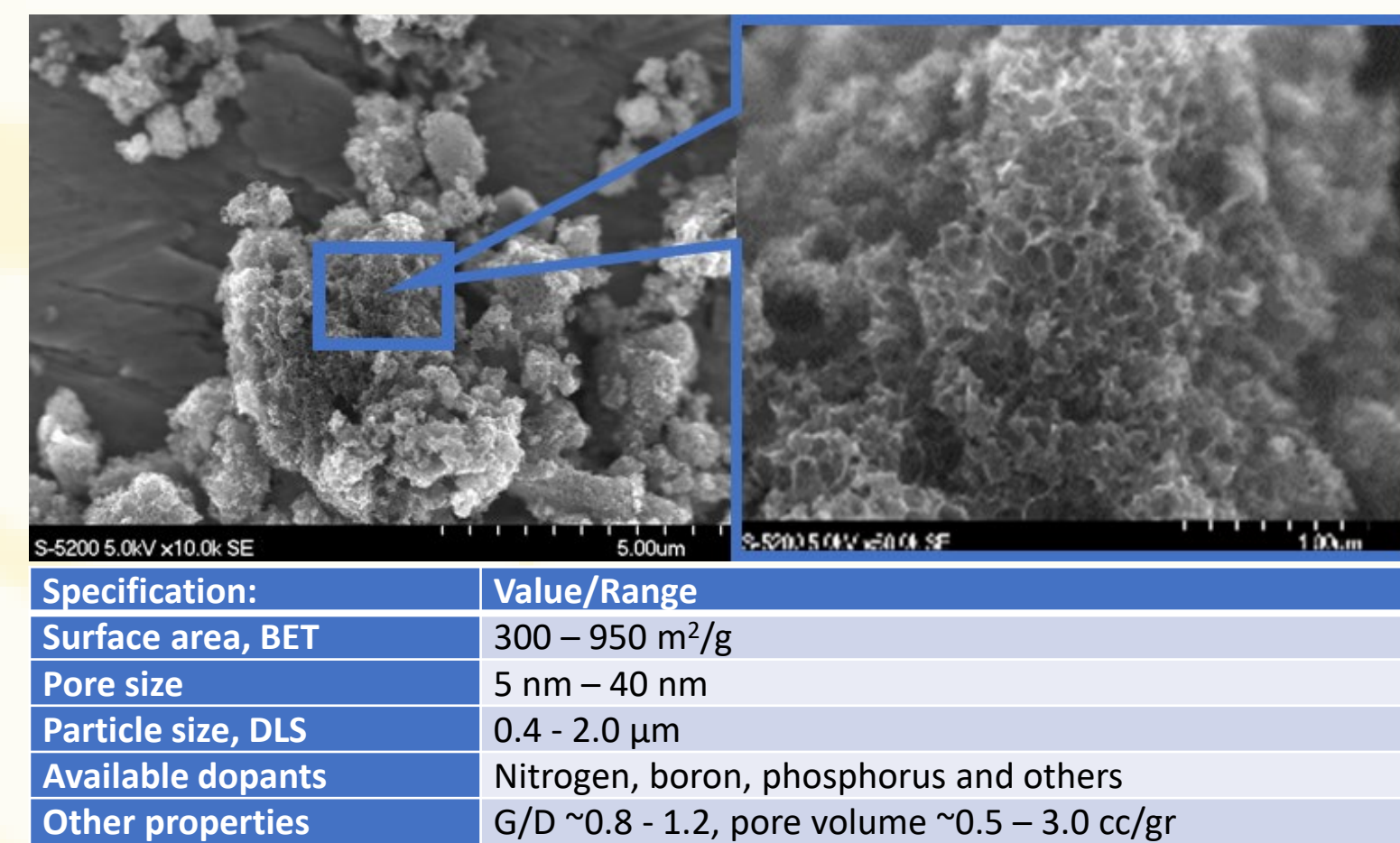
Vision

- Develop precious metal free fuel cell and electrolyzer catalysts for low cost energy storage
- Impact: Enable low cost precious metal free fuel cells and electrolyzers for transportation, backup-power, and renewables grid-level energy storage

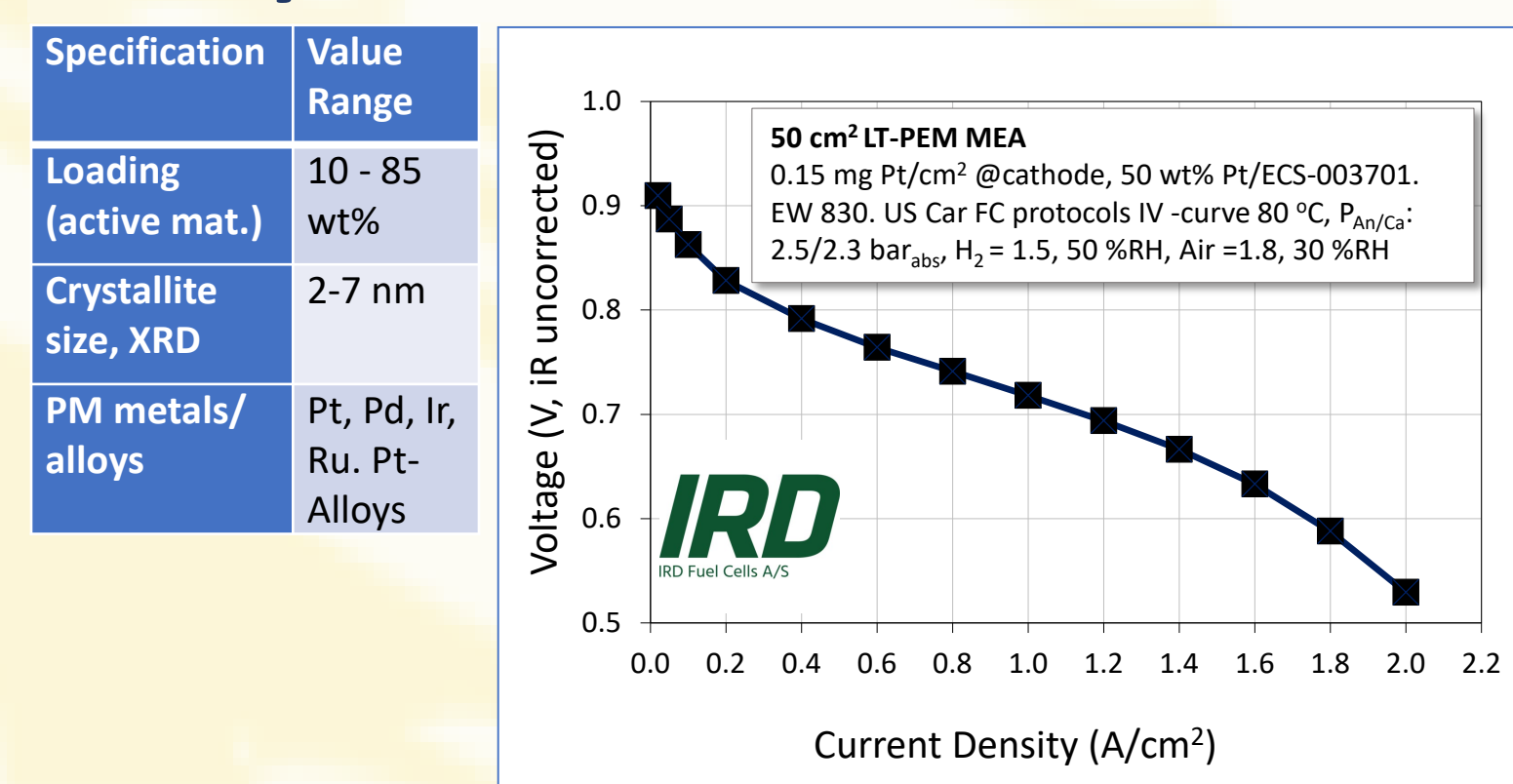
Fed. funding:	\$2.8M
Length:	42 mo.

Products

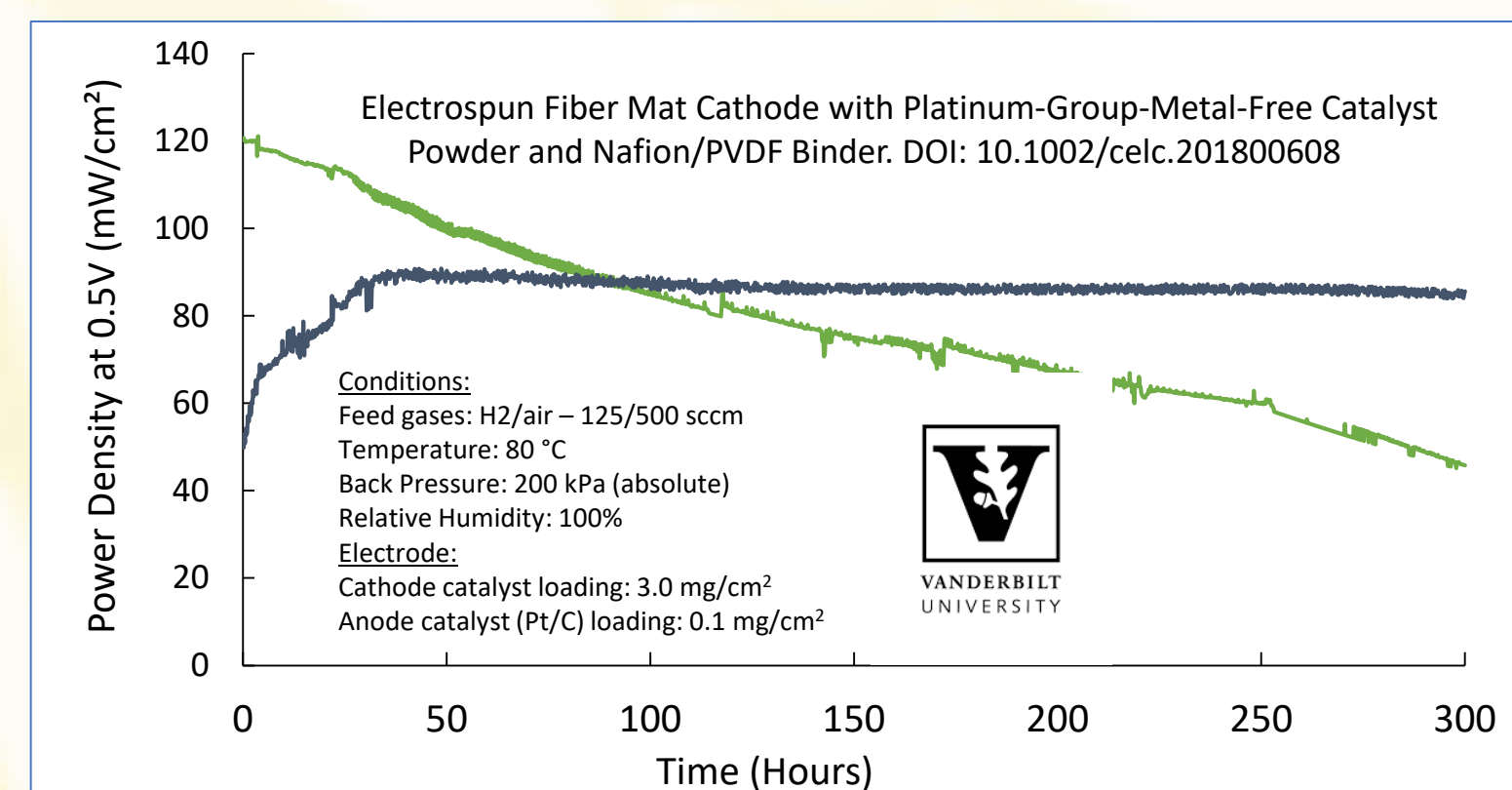
Engineered Catalyst Supports (ECS)



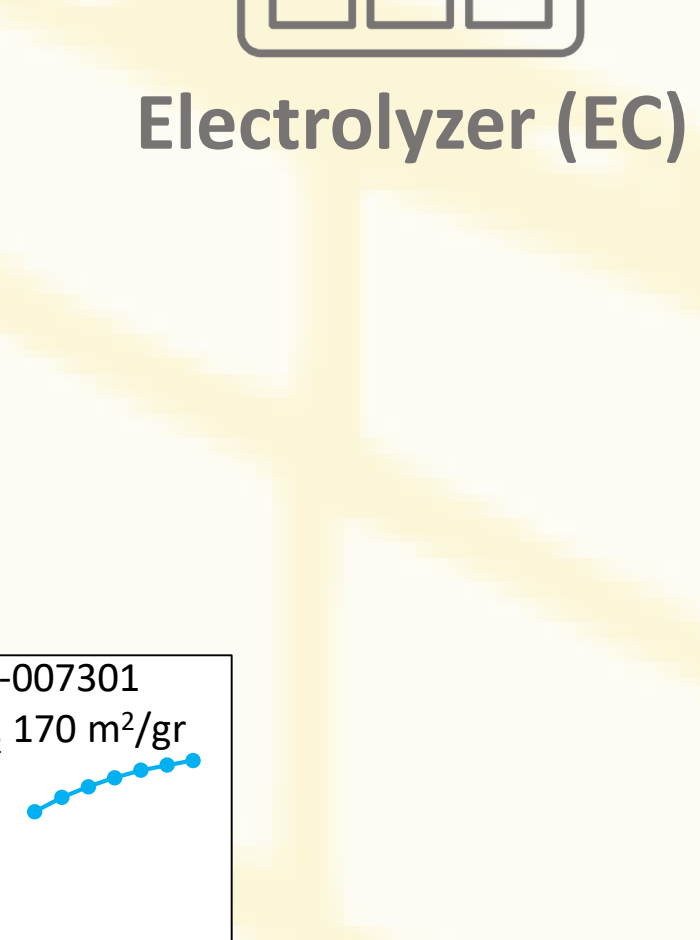
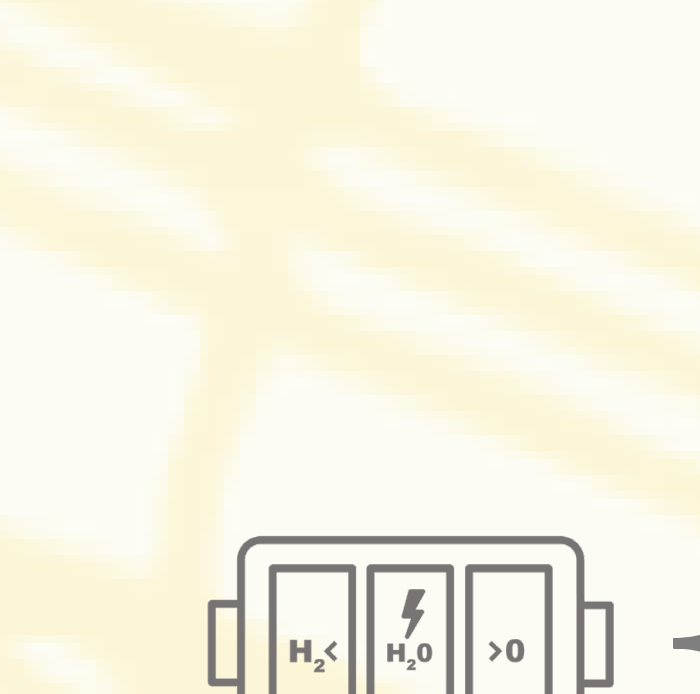
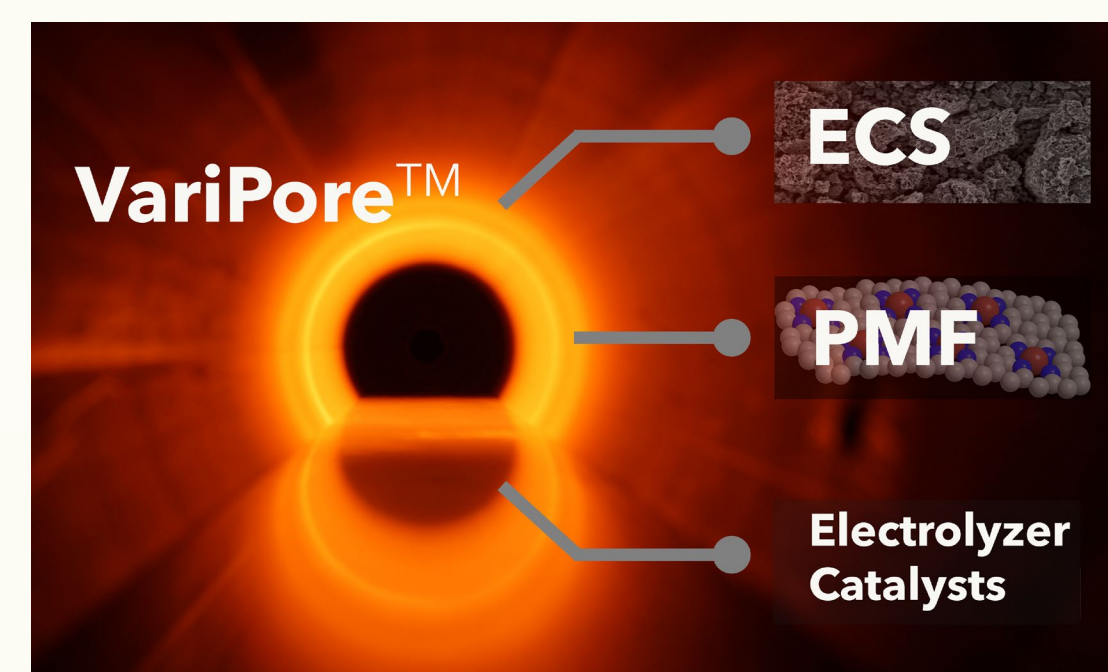
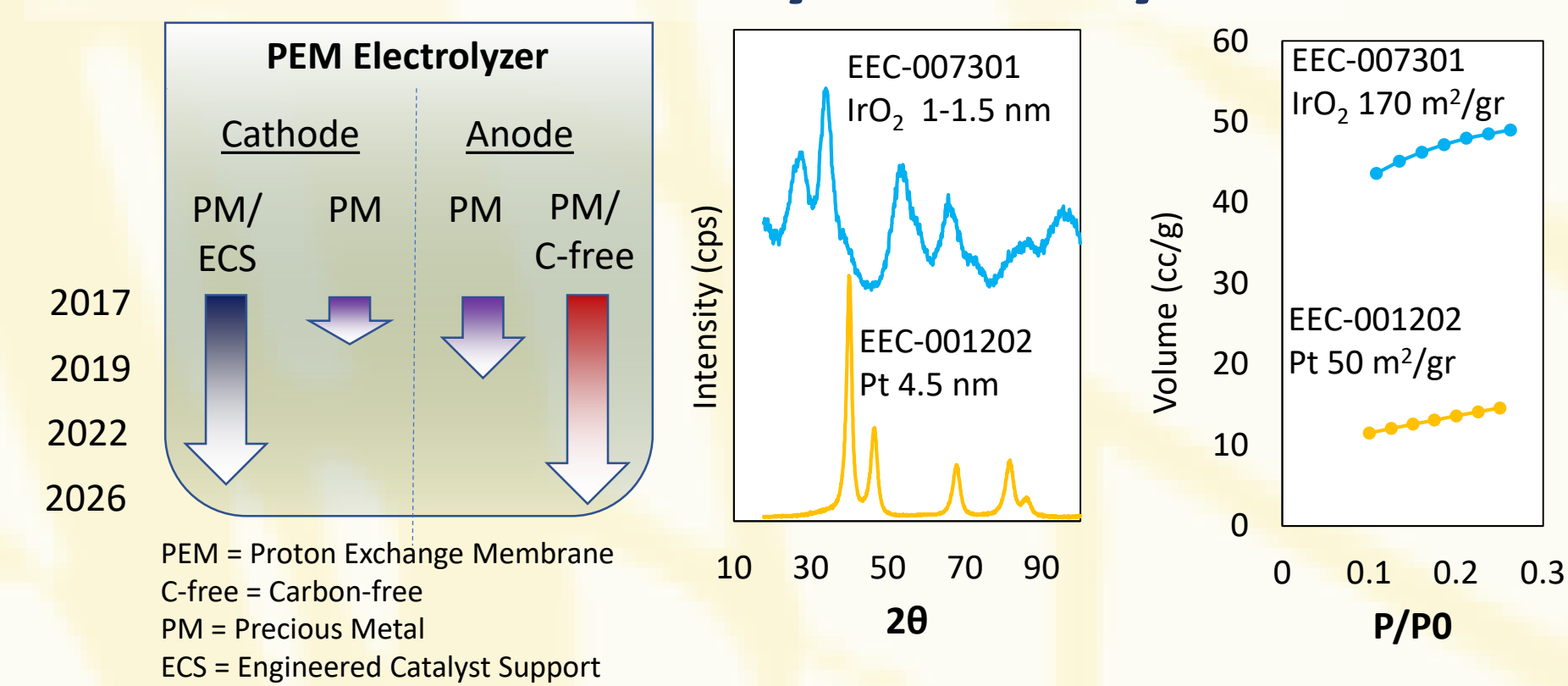
Catalyzed ECS & PEM MEAs



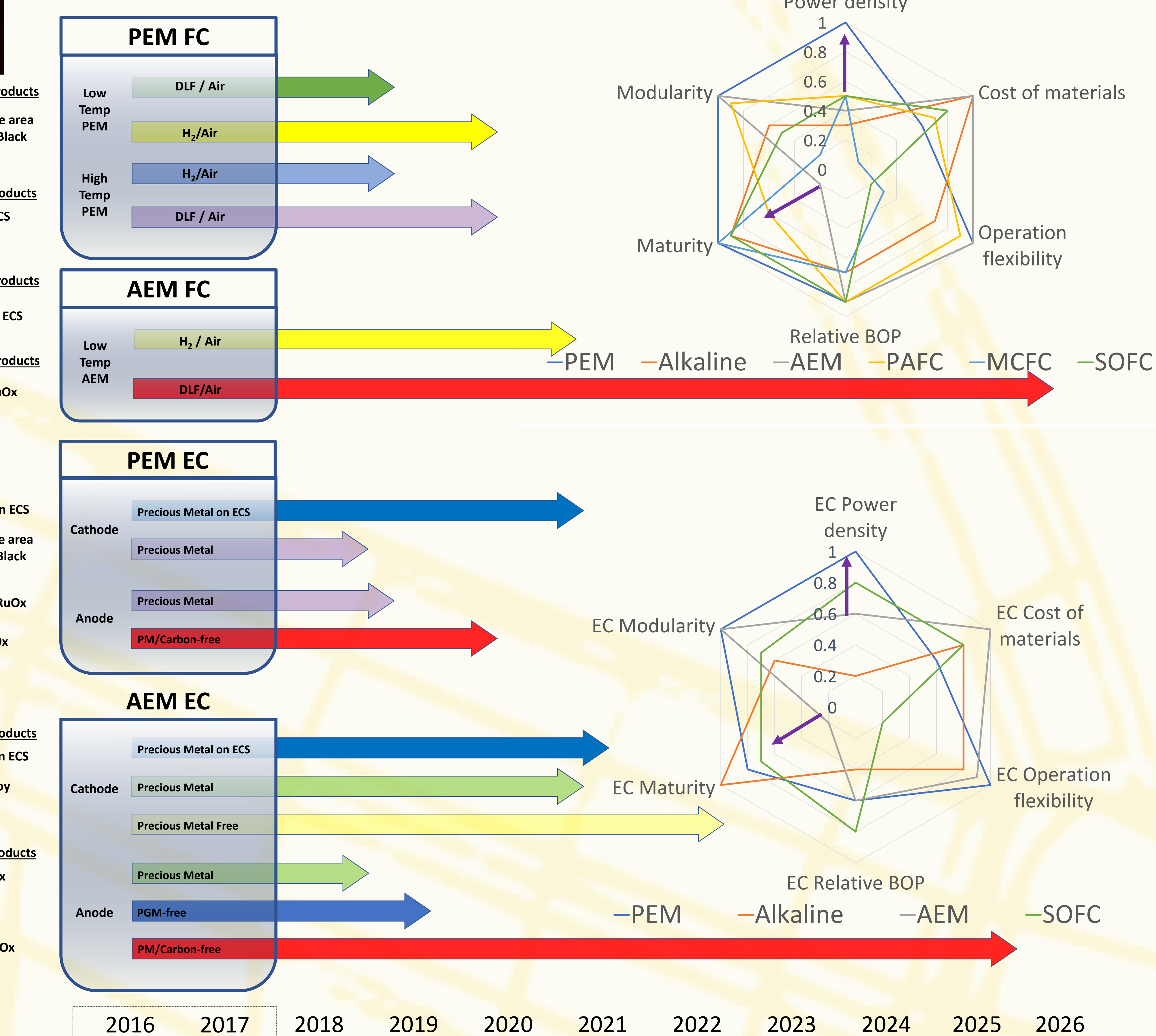
PGM-free ORR Catalysts



PGM-based Electrolysis Catalysts

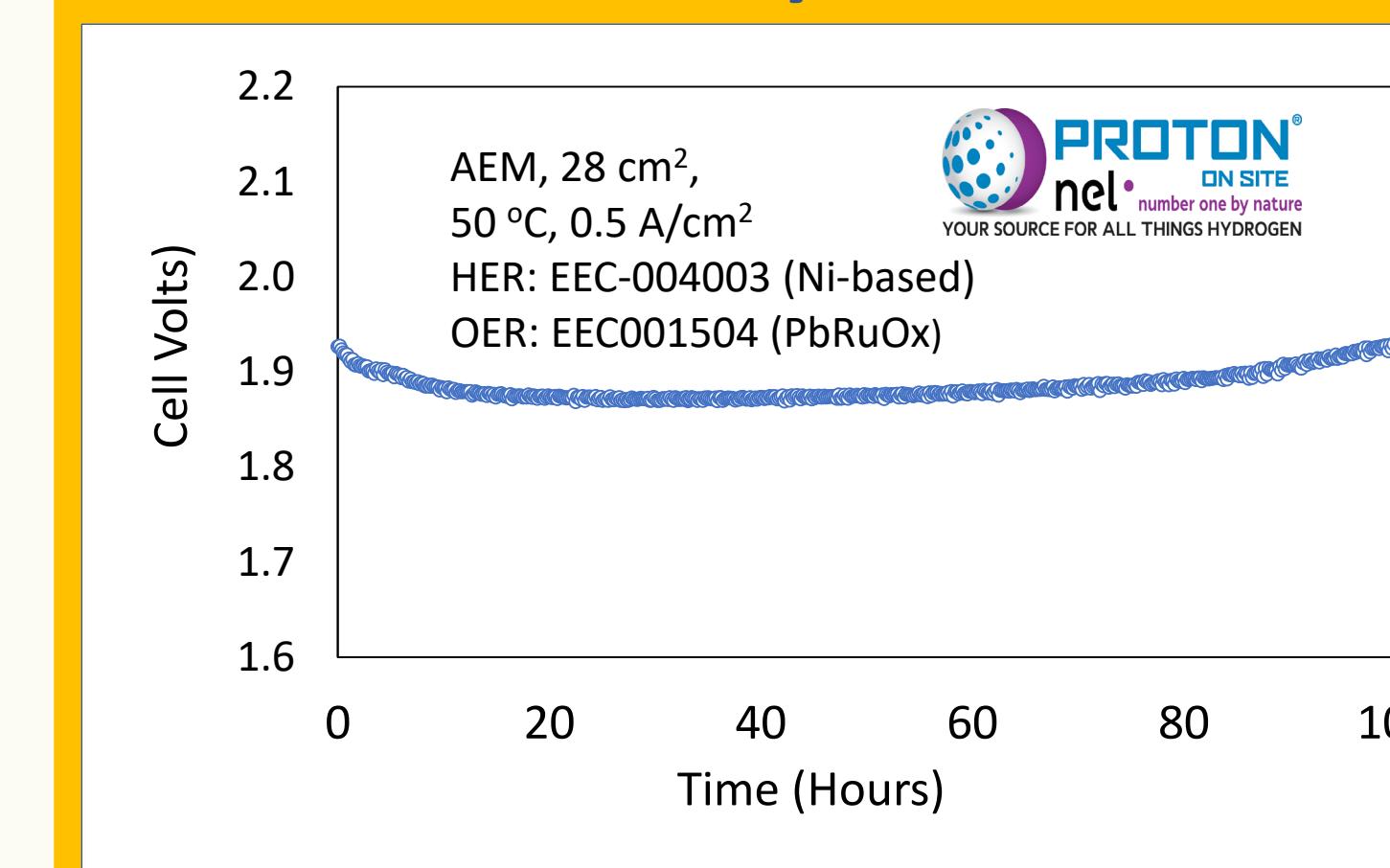


Product Development Roadmap

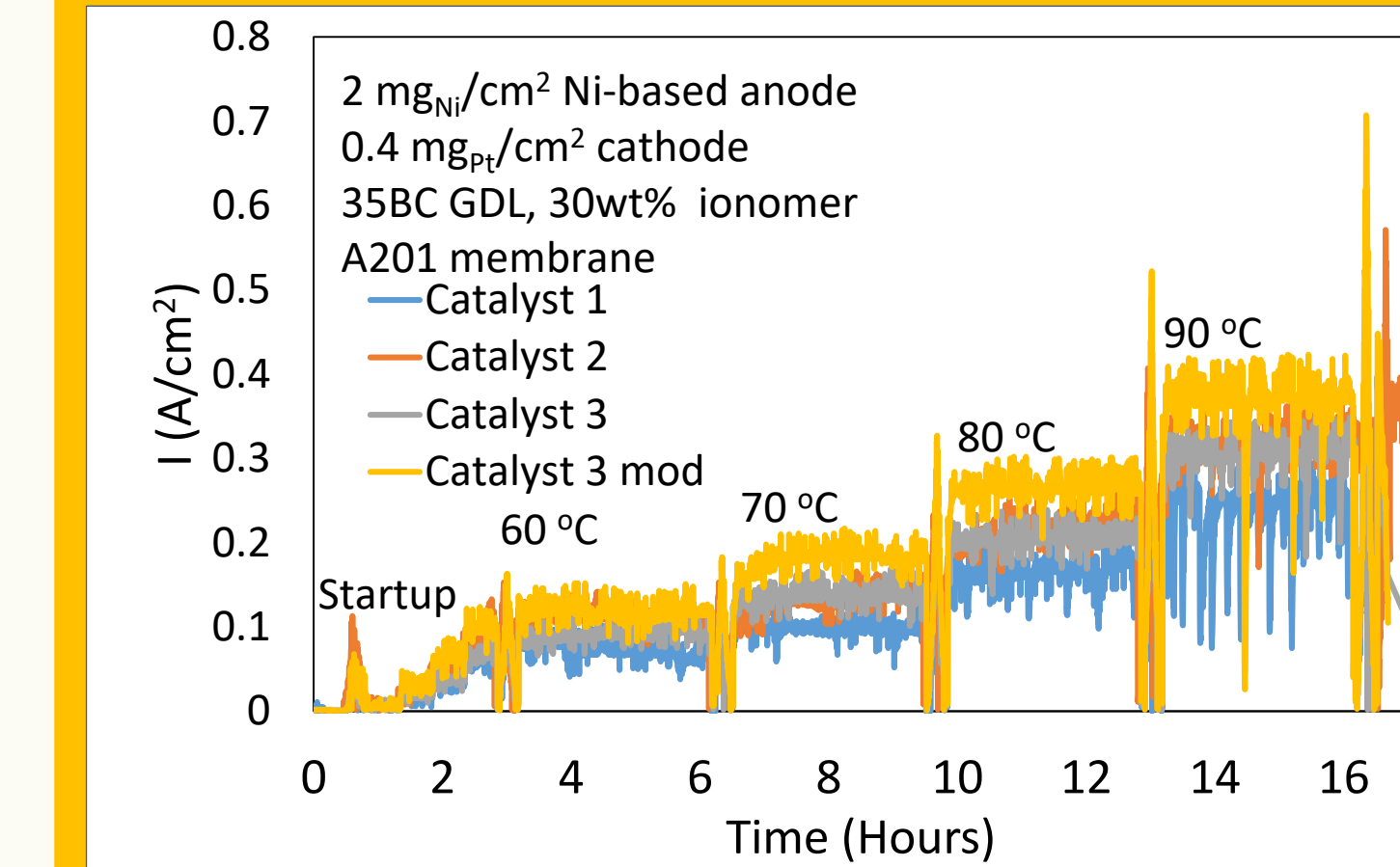


AEM URFC: Key Achievements

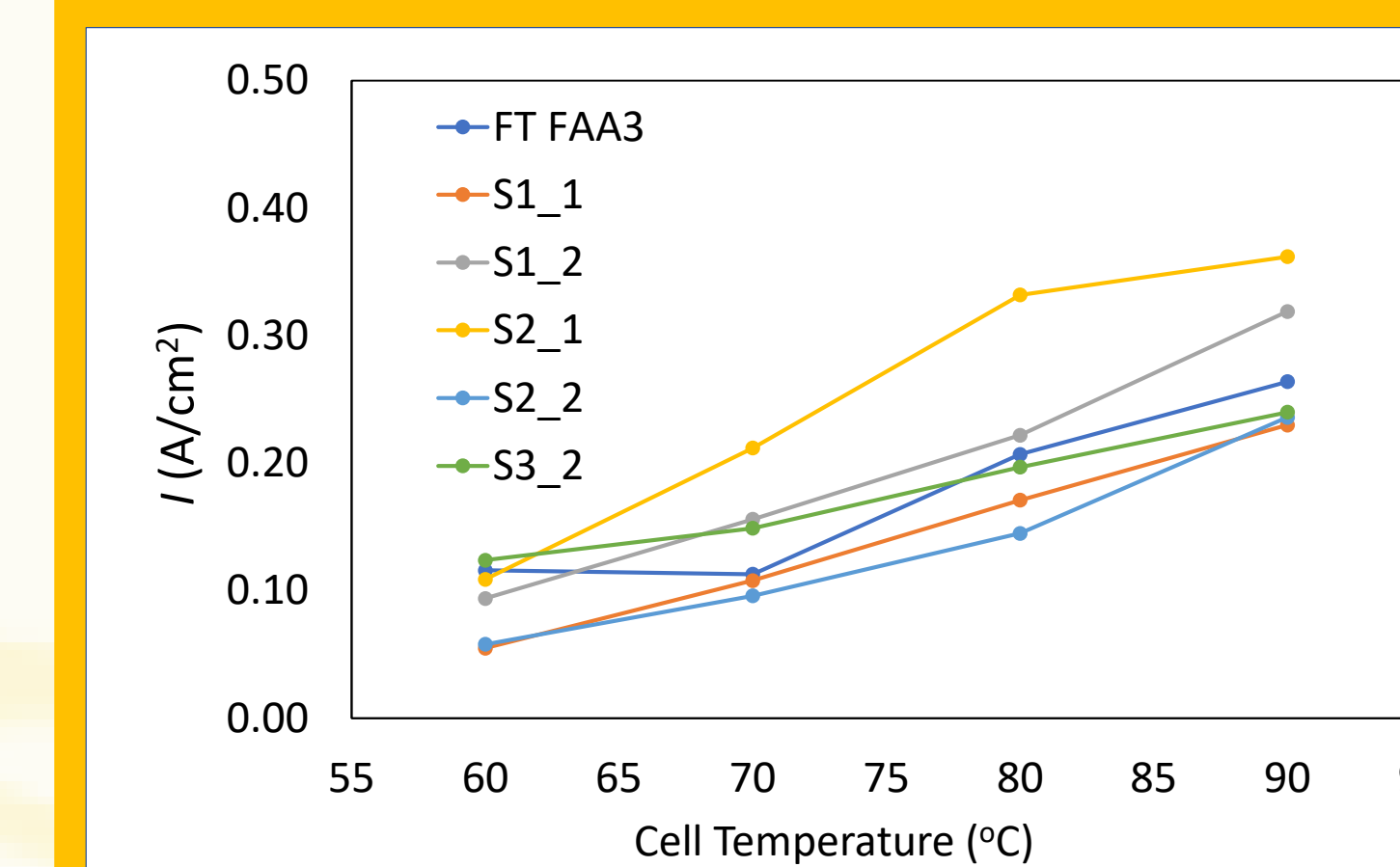
PGM-free Electrolyzer Cathode



PGM-free Fuel Cell Anode



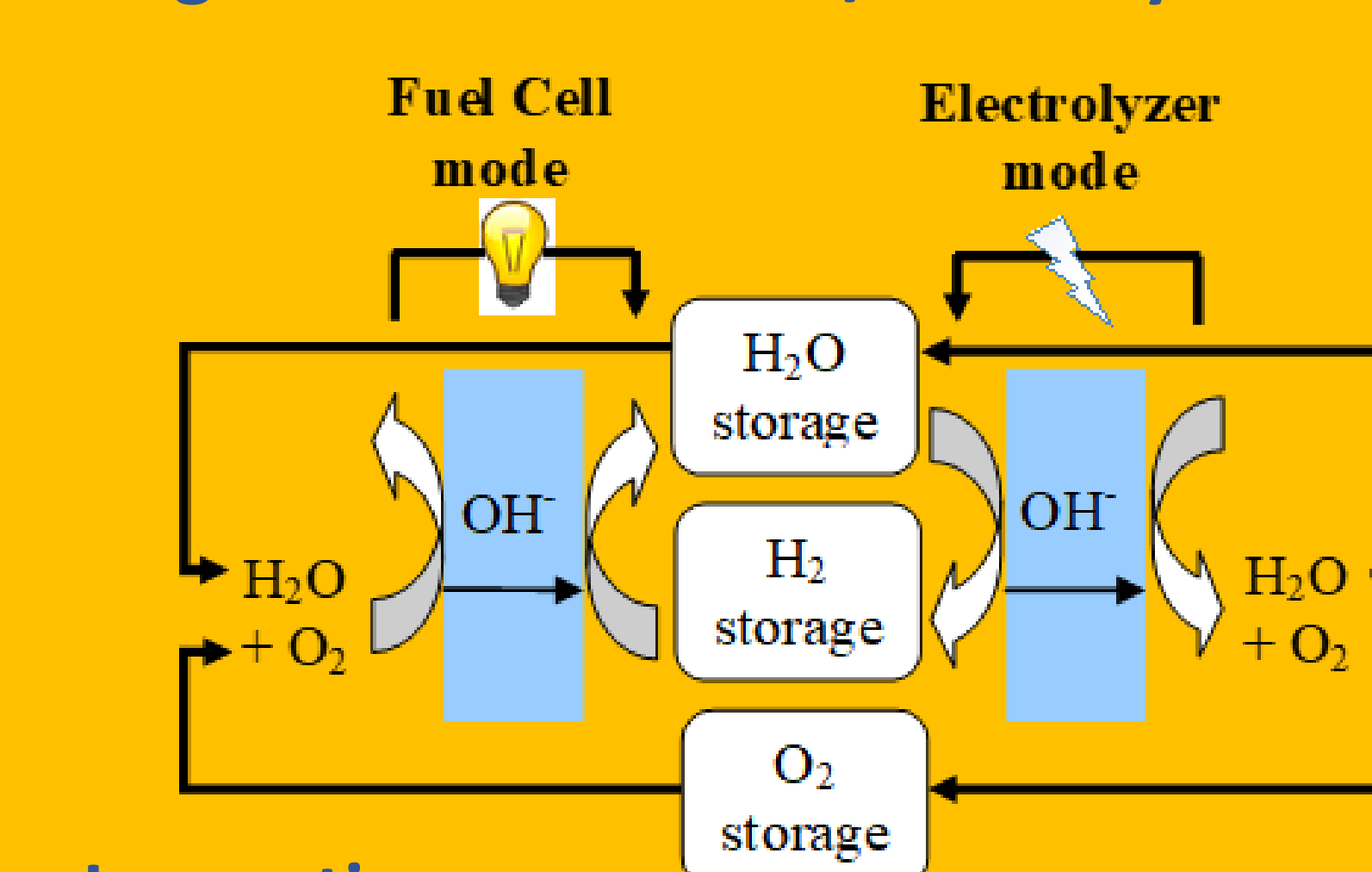
PGM-free Fuel Cell Ionomer Effects



Future Work

- Increased Fuel Cell and Electrolyzer performance and stability
- Unitized Reversible Electrode testing using PGM-free Hydrogen electrodes
- Short-stack demonstration

Regenerative Fuel Cell/Electrolyzer



Innovation

- Elimination of platinum group metals through use of anion exchange membrane technology for fuel cells and electrolyzer
- Focus on the bifunctional hydrogen electrode as the critical remaining enabler to low cost materials

Targets

Metric	S.o.t.A	Proposed
Voltage, 0.35A/cm ² (fuel cell)	0.4 V	0.65 V
Voltage, 0.5A/cm ² (electrolyzer)	2.4 V	2.1 V
\$/kW at stack level (AEM vs PEM)	\$400 (PEM)	\$50 (AEM)

Task Outline

Task and lead	Yr 1	Yr 2	Yr 3
FC catalyst: PP, UNM			
EC catalyst: NU, Proton, PP			
Electrode: Proton, EWII, PP			
T2M: PP, Proton, EWII			

Tech-to-Market Strategy

Short-term: high-value, fault tolerant electrolyzers, electrodes and catalysts for specialty markets
Long-term: reversible fuel cell and components for renewable storage