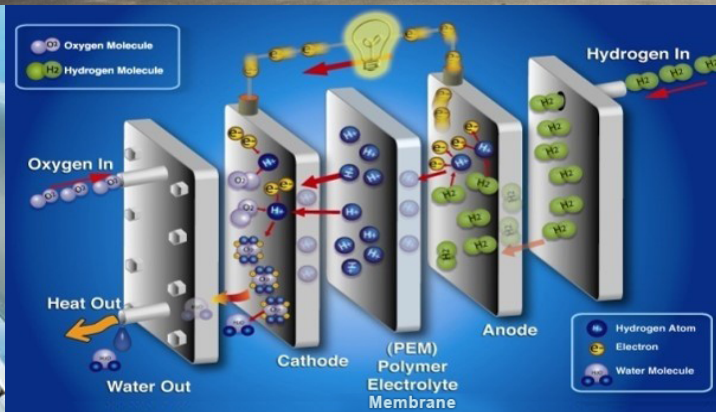


Foundational Research for H2@Scale: Energy Materials Network Consortia

U.S. DEPARTMENT OF
ENERGY

Energy Efficiency &
Renewable Energy



H2@Scale Workshop

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Eric L Miller

H₂ Production & Delivery
Program Manager

Fuel Cell Technologies Office
U.S. Department of Energy



ENERGY MATERIALS NETWORK



ElectroCat

The Electrocatalysis Consortium (ElectroCat) is using national lab resources and capabilities such as Argonne's High-Throughput Research facility (pictured) and Los Alamos' ability to design and synthesize catalysts to speed the development process of PGM-free electrocatalysts for fuel cells.

Photo credit: Argonne National Laboratory

- EMN creates a nexus of industry, government, & laboratory stakeholders with resources focused on accelerating materials innovation into clean-energy products

A Platform for Accelerated R&D



Energy Materials Network

U.S. Department of Energy

The Energy Materials Network (EMN) aims to dramatically decrease time-to-market for advanced materials that are critical to many clean energy technologies.

WORLD-CLASS INNOVATION

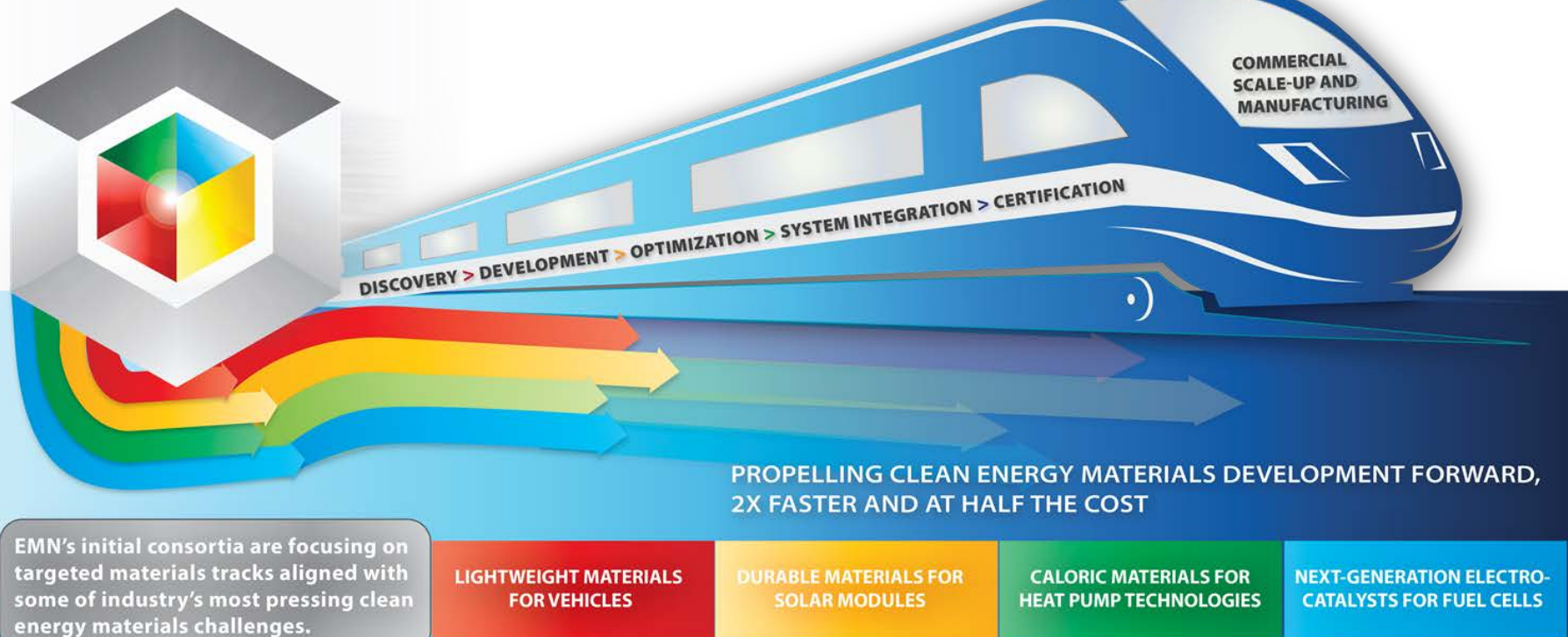
EMN is fueling U.S. industry with leading scientific and technical capabilities, data, and tools, and helping deliver innovative clean energy products to the world marketplace through its network of national lab-led consortia.

CLEAR POINTS OF ENGAGEMENT

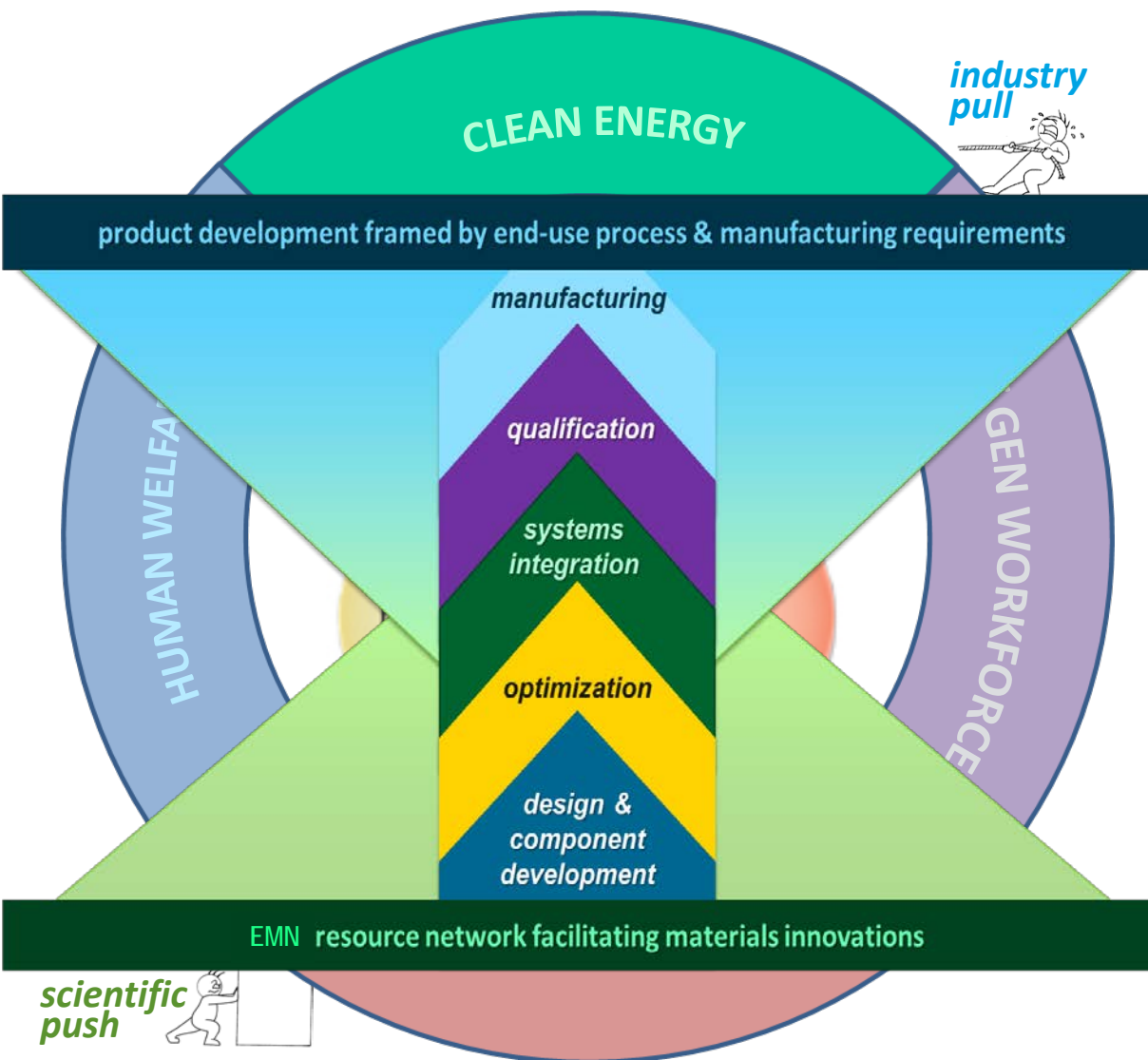
In building an enduring, accessible network, EMN offers industry clear points of engagement and streamlined access to national lab resources by providing technical support, collaboration tools, and data platforms.

RAPID SCALE-UP

EMN is addressing market deployment barriers and getting new technologies to market faster by better integrating all phases of the materials development cycle, from discovery through deployment.



Cutting-edge materials research for critical energy technologies



- The EMN relies on *industry pull* and *scientific push* to work together in the accelerated R&D of important clean energy technologies

Facilitating access to scientific innovation in materials R&D



Energy Materials Network

U.S. Department of Energy

pilots

1. *World Class Materials Capability Network*

Predictive
Simulation
Across Scales

Synthesis &
Characterization

Rapid
Screening

End Use
Performance

Process
Scalability

Process
Control

Real-time
Characterization

Reliability
Validation

Data Management & Informatics

*scientific
push*



2. *Data & Tools Collaboration*

3. *Clear Point of Engagement*

4. *Streamlined Access*

*industry
pull*



H2@Scale

EMN consortia focus on critical clean energy challenges



- *PGM-free catalysts for fuel cells are critical for cost-reductions needed for large-scale market penetration*



- *Breakthrough H₂ storage materials are key to large-scale H₂ energy & possible future on-board storage*



- *H2@Scale depends on a future portfolio of large-scale, low-cost, sustainable H₂O splitting options*



Core Labs

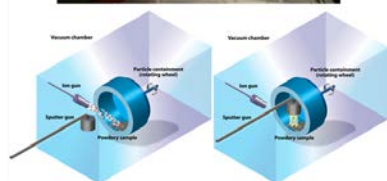
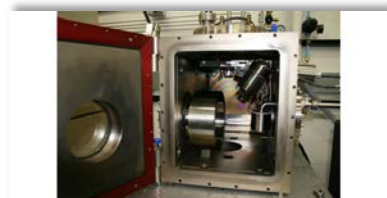


Accelerating the discovery & development of innovative catalyst and electrode materials critical to advanced platinum group metal-free fuel cell technologies

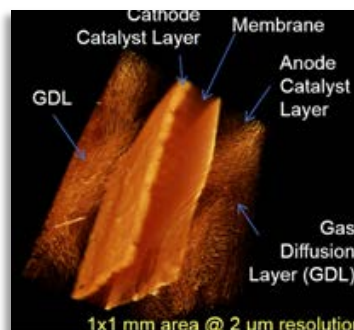
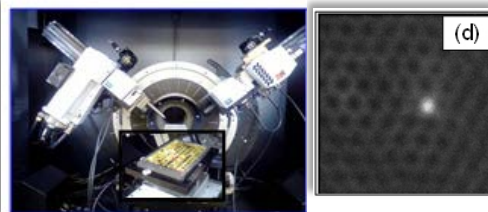
➤ *Comprising world-class capabilities and expertise in:*

- catalyst synthesis, characterization, processing, & manufacturing
- high-throughput, combinatorial techniques
- advanced computational tools

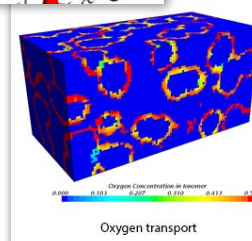
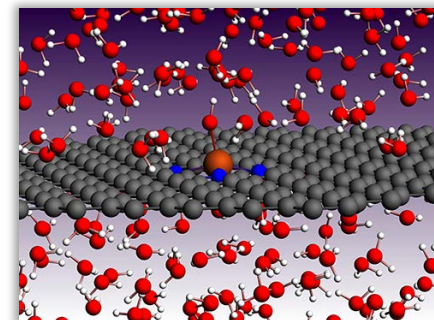
Synthesis, processing and manufacturing



Characterization and Synthesis



Computation, Modeling & Data Management





Core Lab Team

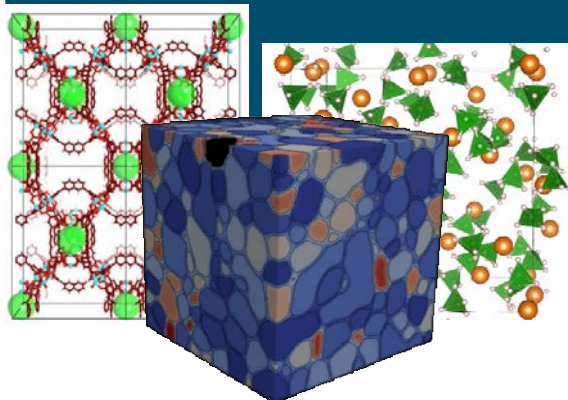


University

Non-profit

Industry

Theory, simulation, & data

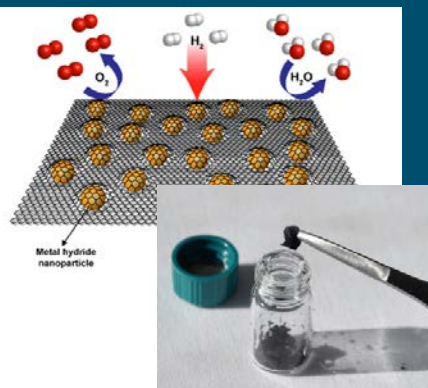


HyMARC will provide capabilities and foundational understanding of phenomena governing thermodynamics and kinetics limiting the development of solid-state hydrogen storage materials

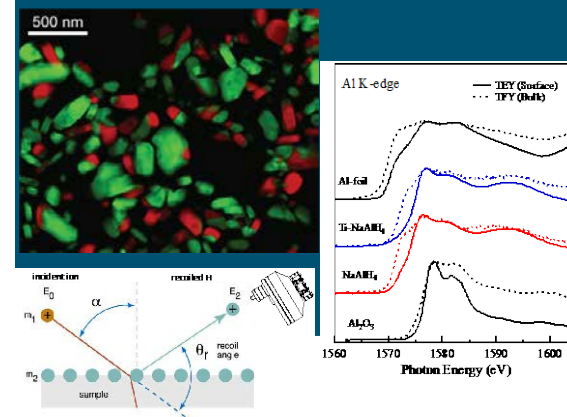
➤ Delivering community tools and capabilities:

- *Computational models and databases for high-throughput materials screening*
- *New characterization tools and methods (surface, bulk, soft X-ray, synchrotron)*
- *Tailorable synthetic platforms for probing nanoscale phenomena*

Controlled synthesis



In situ characterization



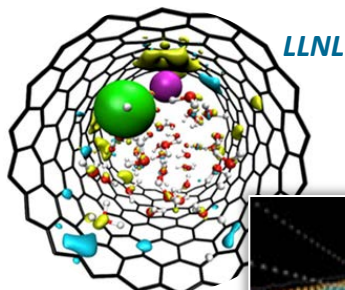


Accelerating discovery & development of innovative materials critical to advanced technologies for sustainable H₂ production, including:

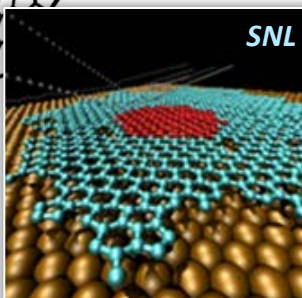
- *Advanced high- and low-temperature electrochemical conversion*
- *Direct photoelectrochemical solar water splitting*
- *Direct solar thermochemical water splitting*

➤ Comprising more than 80 unique, world-class capabilities/expertise in materials theory/computation, synthesis, characterization & analysis:

Materials Theory/Computation

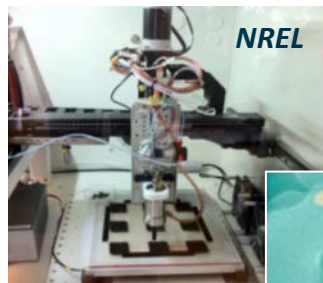


Bulk & interfacial models of aqueous electrolytes

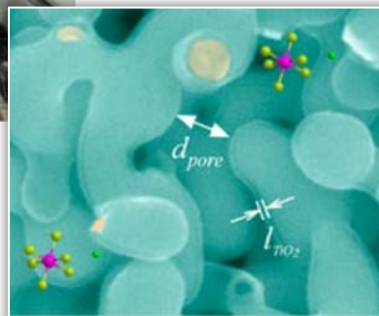


LAMMPS classic molecular dynamics modeling relevant to H₂O splitting

Advanced Materials Synthesis



High-throughput spray pyrolysis system for electrode fabrication



Conformal ultrathin TiO₂ ALD coating on bulk nanoporous gold

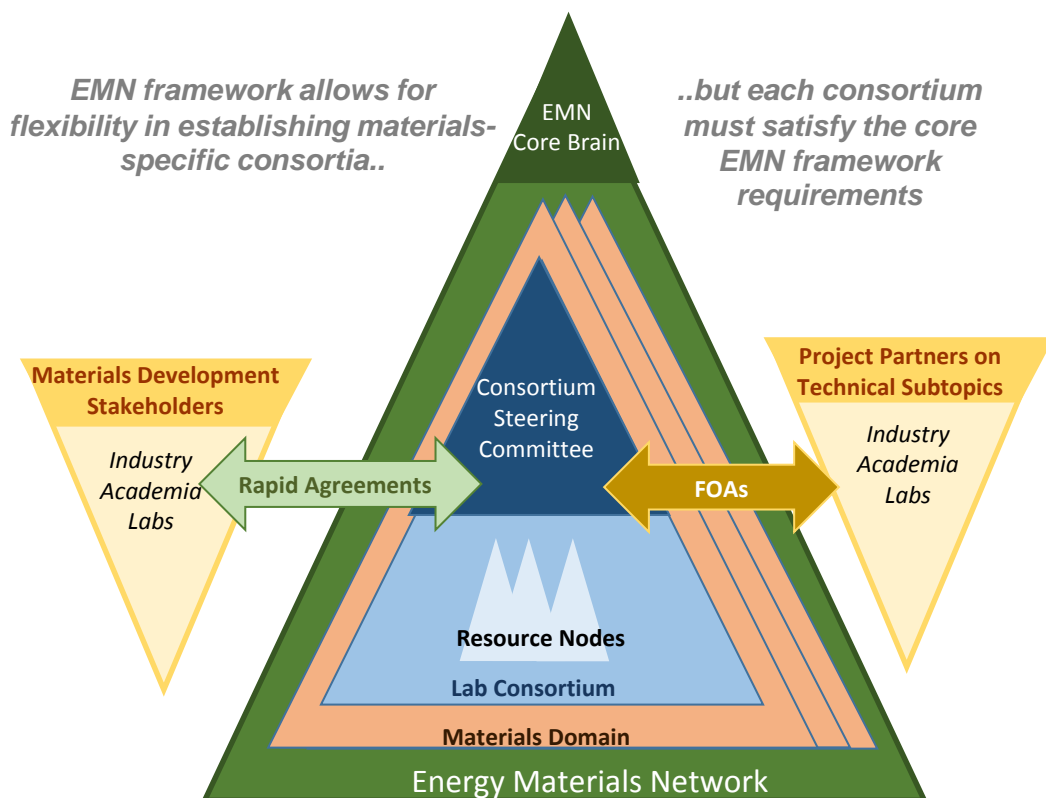
Characterization & Analytics



Stagnation flow reactor to evaluate kinetics of redox material at high-T



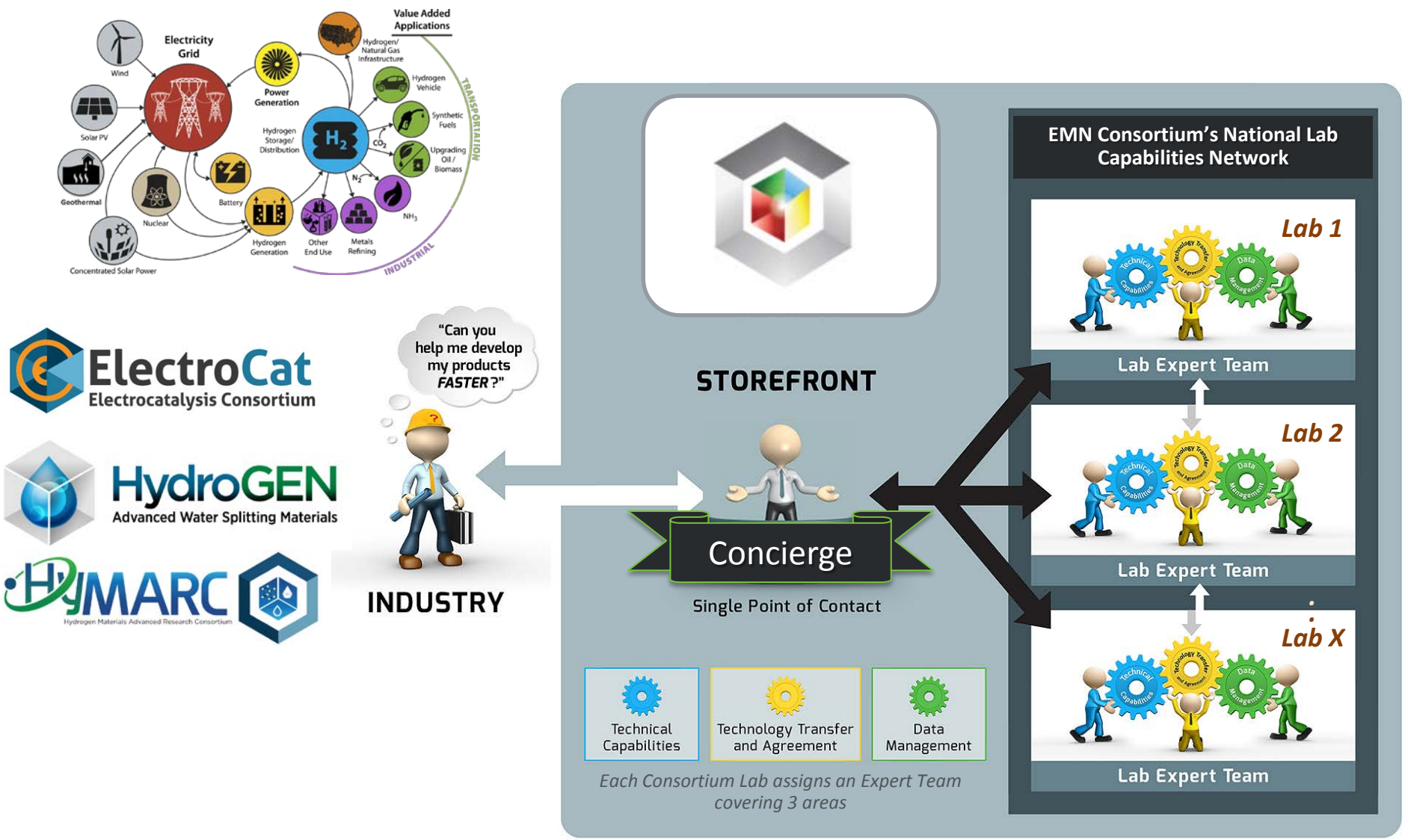
TAP reactor for extracting quantitative kinetic data



- The EMN leverages National Lab resources to foster foundational materials R&D for important clean energy applications
- The EMN framework facilitates streamlined access for industry and academic stakeholders



EMN innovation ecosystem facilitates foundational H2@Scale R&D



Single points of contact facilitate stakeholder/consortia interactions



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THANK YOU!

Eric L. Miller
eric.miller@ee.doe.gov

<http://energy.gov/eere/transportation/hydrogen-and-fuel-cells>