

## EMN Framework Examples

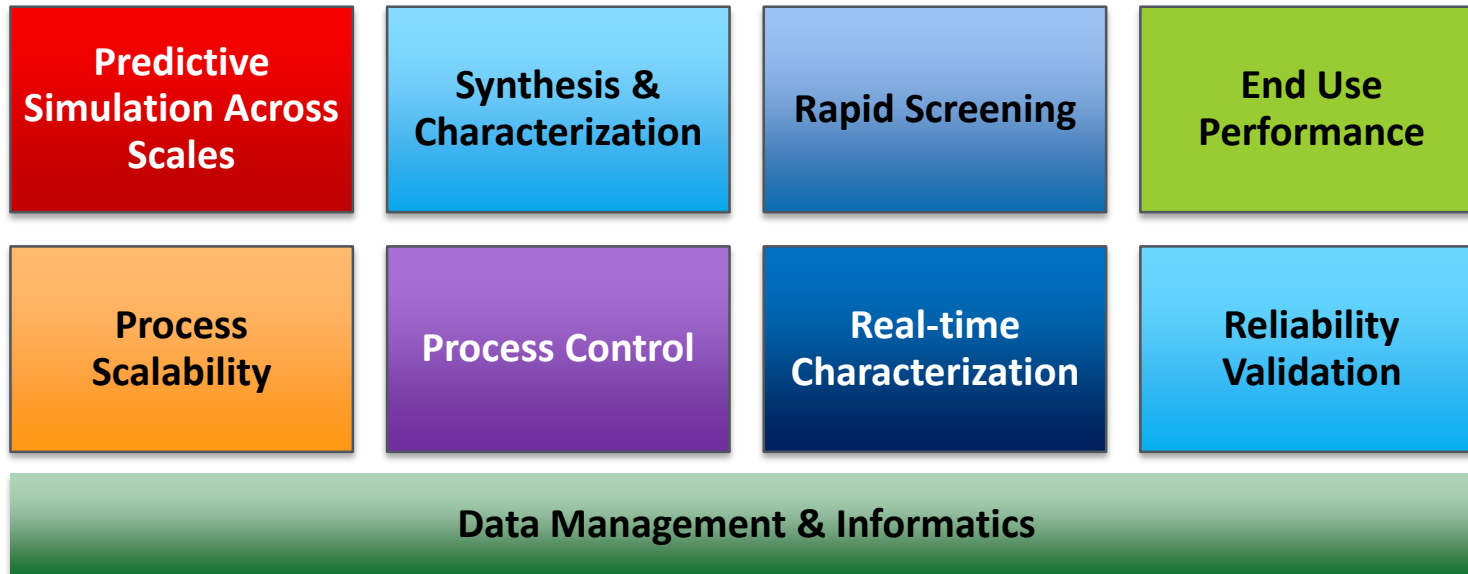
Palo Alto, CA  
April 15, 2016

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# EMN Alignment with MGI and AMP

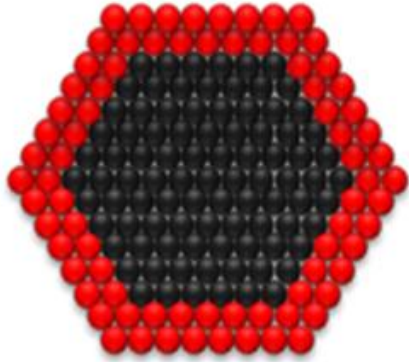
*Coordinated resource network with a suite of capabilities for advanced materials R&D*



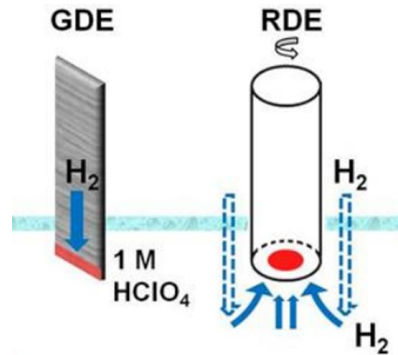
**Goal: Engage industry, academia, and the national labs across the materials development cycle.**

*New Material Innovations for Clean Energy 2X Faster and 2X Cheaper*

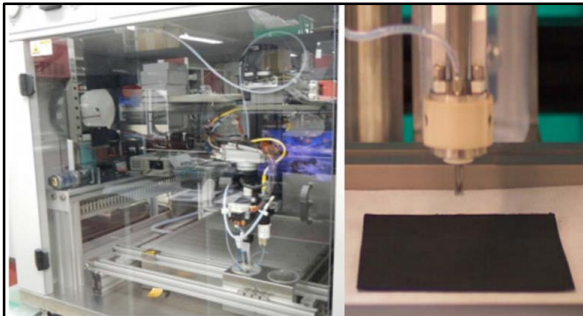
# Successful FCTO Projects Engaging Industry



**Core-shell nanocatalysts (Pt/Ru and Pt/Ir) for electrolyzer cathodes and anodes developed by adapting BNL process. (Proton Onsite)**



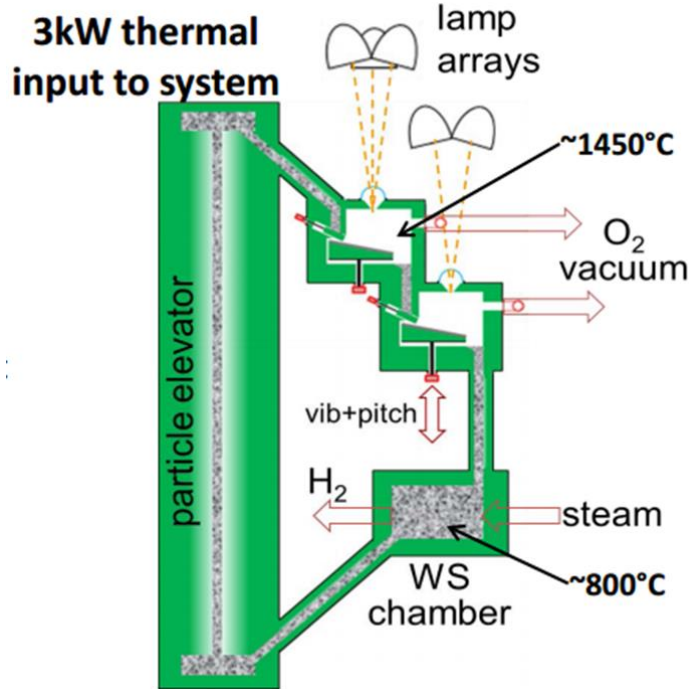
**“Hanging strip” method developed at BNL to characterize catalyst activity**



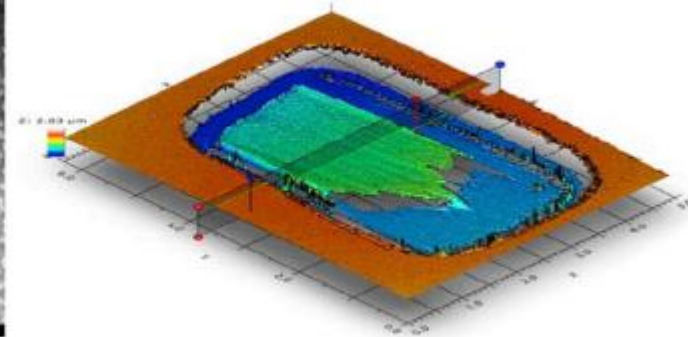
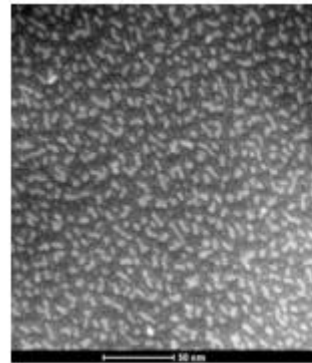
**Catalyst synthesis on gas diffusion electrodes scaled up using ultrasonic spray deposition (Proton/BNL)**

***BNL and Proton collaboration led to >50% reduction in anode/cathode catalyst loading.***

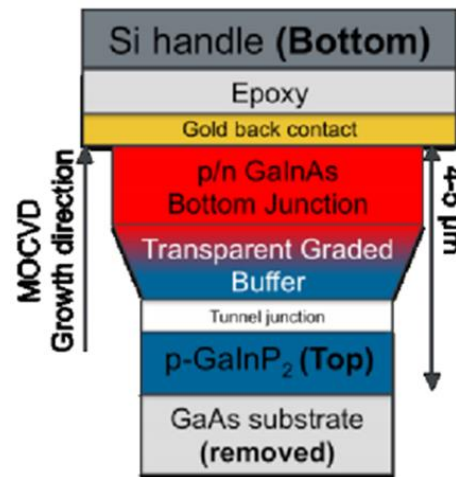
# Unique capabilities developed by FCTO



**Cascading pressure receiver reactor**  
**SNL**



**N+ ion bombardment process**  
 patented by NREL



**Inverted metamorphic multijunction (IMM) PEC cell,**  
**NREL**  
*2008 R&D 100 Award,*  
*2009 Award for Excellence in Technology Transfer*

*FCTO funding routinely develops unique capabilities at the labs.*



# DOE Mechanisms to Engage Stakeholders



(hereinafter "Participant")  
 both being hereinafter jointly referred to as the "Parties"

ARTICLE E: DEFINITIONS

A. "Government" means the United States of America and agencies thereof.

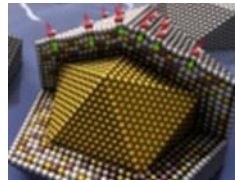
## CRADAs/WFO/ ACT Program



## Energy Materials Network

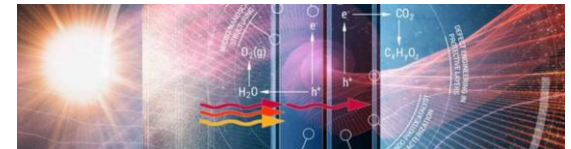
U.S. Department of Energy

### Materials Project



FC-PAD, HyMarc

### EFRCs/Energy Innovation Hubs

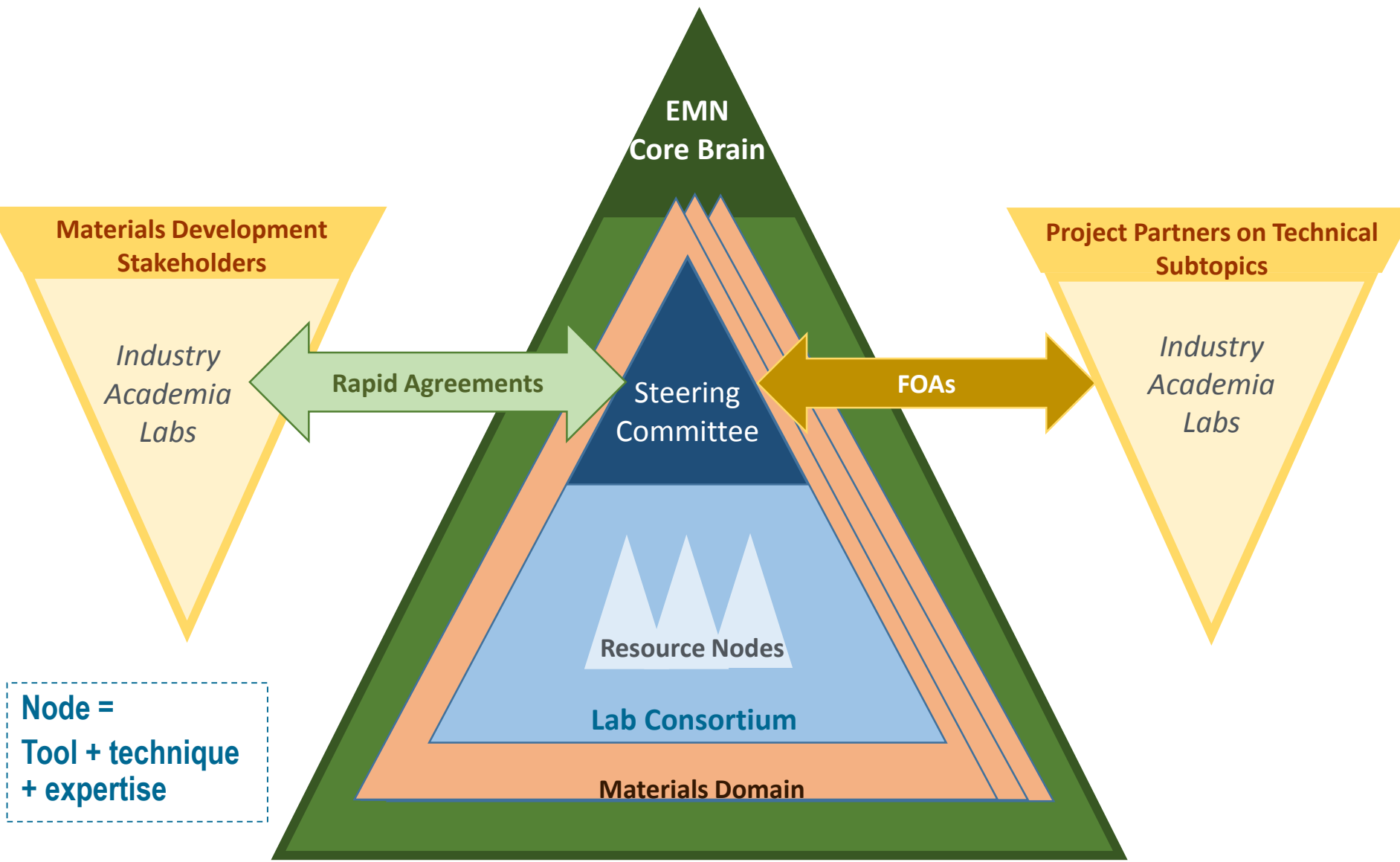


**EMN will leverage best practices from existing/past DOE efforts.**

1. **WORLD CLASS MATERIALS CAPABILITY NETWORK**: Create and manage a *unique, accessible set of capabilities* within the DOE National Laboratory system
2. **CLEAR POINT OF ENGAGEMENT**: Provide a *single point-of-contact* and concierge to direct interested users (e.g. industry research teams) to the appropriate laboratory capabilities, and to *facilitate efficient access*.
3. **DATA AND TOOL COLLABORATION FRAMEWORK**: *Capture data, tools, and expertise* developed at each node such that they can be *shared and leveraged* throughout the EMN and *in future programs*. Establish data repositories and, where appropriate, distribute data to the scientific community and public. Accelerate learning and development through data analysis using advanced informatics tools.
4. **STREAMLINED ACCESS**: Facilitate *rapid completion of agreements* for external partners, and aggressively pursue approaches to reduce non-technical burden on organizations seeking to leverage the EMN for accelerated materials development and deployment.

*EMN consortia will follow key principles to improve collaboration in materials development.*

# EMN Structure and Taxonomy



*Each consortium will assemble national lab resources, led by a Steering Committee.*

# EMN Structure and Taxonomy

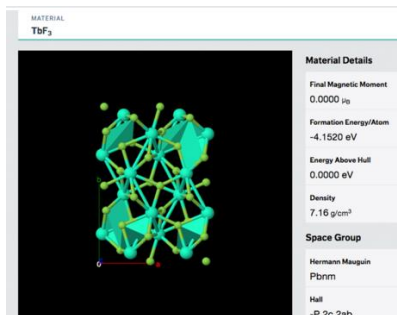


## Steering Committee/Concierge:

- **Technical capabilities experts** from each lab that guide interested users to appropriate capabilities within the consortium for their application, and participate in outreach.

**Data Management Experts:** Curate data from consortium R&D in an online database. In out-years, predictive capabilities may be added to these databases, along with varying levels of security to protect proprietary data.

**TT/A Experts:** Establish short-form agreements at each lab that are relatively consistent across the consortia and can enable access in a matter of weeks.



(hereinafter "Participant")

both being hereinafter jointly referred to as the "Parties"

### ARTICLE I: DEFINITIONS

- "Government" means the United States of America and agencies thereof.
- "DOE" means the Department of Energy, an agency of the United States of America.
- "Contracting Officer" means the DOE employee administering the Contractor's I contract.
- "Generated Information" means information produced in the performance of this CRADA.
- "Proprietary Information" means information which is developed at private expense outside of this CRADA, is marked as Proprietary Information, and embodies (i) secrets or (ii) commercial or financial information which is considered privileged confidential under the Freedom of Information Act (5 USC 552(b)(4)).

***Each member lab will have three designated "experts".***



# Current EMN Consortia: LightMat


- Discover, manufacture, and deploy advanced materials (e.g. high-strength steels and low-cost carbon fibers) to light-weight vehicles.
- Led by PNNL, with 9 total member labs
- Stakeholders engage through CRADAs, FOAs, and/or direct funded support
  - FY16 FOA on Mg sheet production

The screenshot shows the LightMAT website interface. At the top, there are navigation links for 'ABOUT', 'CAPABILITIES', and 'NEWS'. The main header features the LightMAT logo and the text 'Lightweight Materials CONSORTIUM'. Below the header, there is a breadcrumb trail: 'Home » Capabilities » Extreme Environment Testing'. A prominent red button displays the contact email: [contact@lightmat.org](mailto:contact@lightmat.org). The main content area is titled 'LightMAT Capabilities' and includes a paragraph explaining the resource network. Below this is a table listing various capabilities, their associated national laboratories, and brief descriptions. To the right of the table is a search and filter interface with a 'Reset Filters' button, a 'Search Capabilities' section with an input field and a 'Search' button, and a 'National Laboratory' section with checkboxes for Oak Ridge National Laboratory (9), Sandia National Laboratories (5), and Pacific Northwest National Laboratory (3).

Capability	National Lab	Description
Tribological Testing and Modeling	Oak Ridge National Laboratory	Oak Ridge National Laboratory is a national leader in tribological research and development (R...
Transport and Thermophysical Properties	Oak Ridge National Laboratory	Oak Ridge National Laboratory provides world-class facilities and a staff of technical experts for determining transport and thermophysical properties, such as thermal conductivity, diffusivity,...
Atom Probe Tomography (Cameca LEAP 3000)	Sandia National Laboratories	The Cameca LEAP 3000 atom probe is a voltage-pulsed instrument that allows three-dimensional atomic characterization of metals.
Evaluation of Mechanical Properties of Materials and Structures	Oak Ridge National Laboratory	The Mechanical Properties & Mechanics Group at Oak Ridge National Laboratory manages a large collection of mechanical testing equipment with capabilities to conduct uni- and multi-axial tests,...

*LightMat will provide rapid, easy access to vehicle light-weighting capabilities.*

- Discover, characterize, and scale non-PGM catalysts, electrodes, and membranes for fuel cells
- Develop predictive models, and tools for visualization, and high-throughput synthesis/characterization
- Co-led by ANL/LANL
- Supporting FY16 FOA



## PGM-free electrocatalysts for next-generation fuel cells

### Accelerating the Deployment of Fuel Cell Systems

The ElectroCat (Electrocatalysis) Consortium is aimed at increasing U.S. competitiveness in manufacturing fuel cell electric vehicles (FCEVs) and other fuel cell energy conversion devices by addressing the primary challenges to the widespread implementation of this technology. The precious metal electrocatalysts that are the current standard in fuel cell systems are expensive and restrict the ability to develop fuel cells that are cost-competitive with traditional hydrocarbon-based power sources. In this sense, catalyst design represents the most pressing material barrier related to fuel cell deployment. ElectroCat is addressing this barrier by accelerating the development and deployment of platinum group metal-free (PGM-free) electrocatalysts in fuel cells. To do this, the Consortium is employing a systematic approach in which potential catalysts are synthesized and analyzed rapidly and comprehensively using high-throughput, combinatorial methods. These in turn are guided by computational work and the fundamental electrocatalysis and materials knowledge housed across the national laboratory network. Streamlined data sharing with industry and academia partners is critical to the ElectroCat approach, rapidly building an understanding of PGM-free electrocatalysts across the field and ultimately, enabling the incorporation of those materials into next-generation fuel cells.

### Working with ElectroCat

Industry and academia can engage with ElectroCat in several ways, participating through competitively selected U.S. Department of Energy-funded projects or via standard national laboratory partnerships.

These include:

- Cooperative Research and Development Agreements (CRADAs),
- Funding Opportunity Announcement (FOA) awards, and
- Strategic Partnership Projects (SPPs)

## Consortium will study:

- **Advanced electrolysis materials**
- **Photoelectrochemical water splitting materials**
- **Solar thermochemical water splitting materials**

## Goals:

- **Better integrate TEA/LCA and fundamental R&D to define materials and system level targets**
- **Identify future resource needs for the consortium that should be developed**

# Thank You

## Questions?

[hydrogenandfuelcells.energy.gov](https://hydrogenandfuelcells.energy.gov)