

METALLIC: A Destination for CMM Innovation

The Minerals to Materials Supply Chain Research Facility



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**NETL Resource Sustainability Project
Review Meeting**

April 2-4, 2024



METALLIC: The Challenge



Understanding the Context & Framing the Problem

Challenge: Address the urgent Research, Development, Demonstration, and Deployment (RD3) needs of the entire critical minerals & materials (CMM) supply chain – from extraction to manufacturing – with \$75 million.

Constraints & Guiding Principles:

1. **URGENT:** Focus on immediate, meaningful actions that can be stood up rapidly and produce near-term results.
2. **EFFICIENT:** Tightly coordinated with existing programs and BIL activities. Be complementary, not duplicative.
3. **IMPACTFUL:** Early and regular engagement with industry to ensure greatest impact to nation. Includes regular re-alignment points to streamline industry collaboration.
4. **INCLUSIVE:** Foster an openly collaborative model which attracts talent and expertise.

METALLIC: The Vision



How We Will Enable the Establishment of Domestic CMM Supply Chains

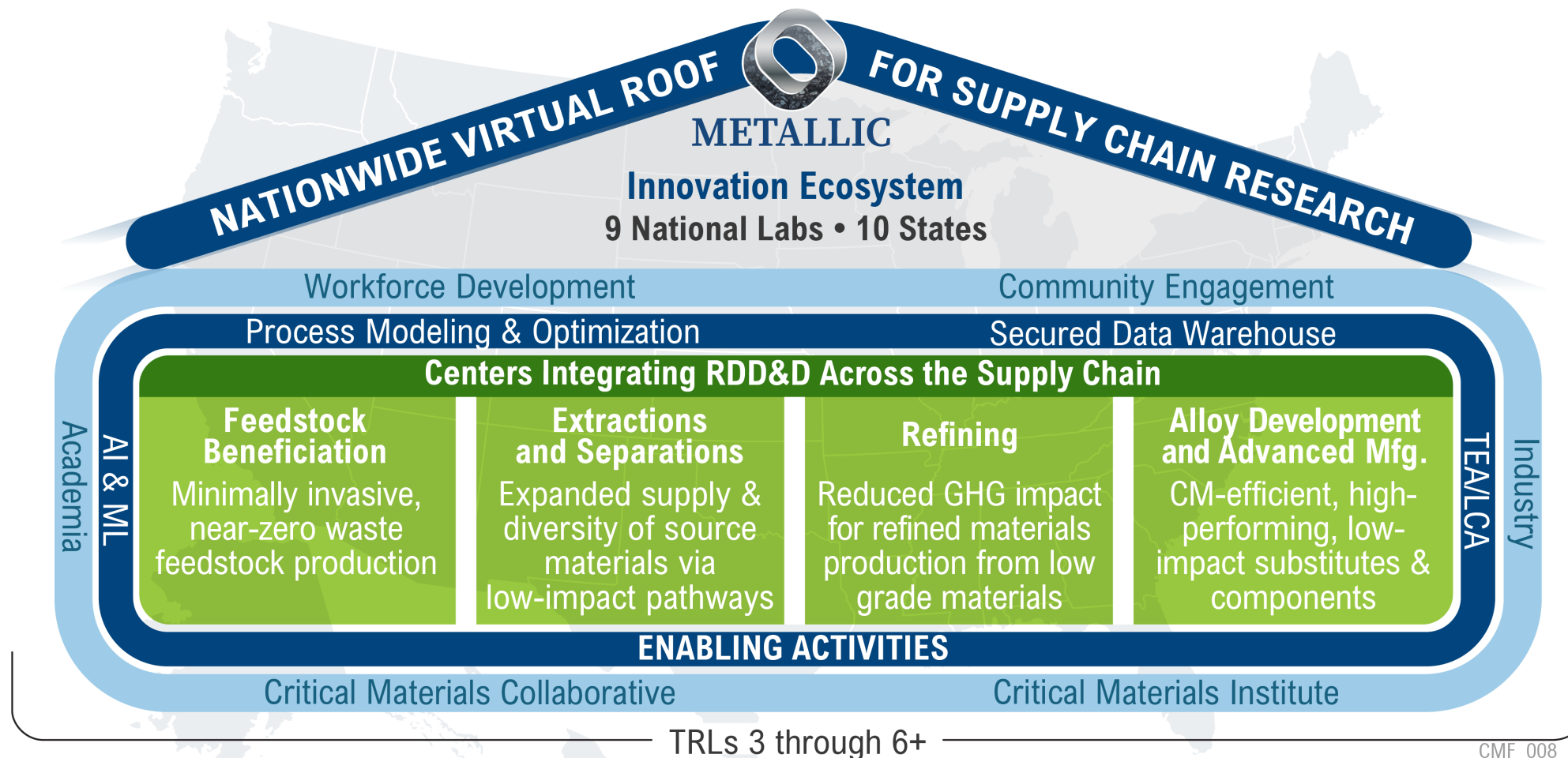
Our Vision:

Establish a facility that is the destination for:

1. **Accelerating CMM RD3** by providing technology developers with context, development support, facilities, and expertise;
2. **Validation of Nascent and Emerging Technologies**, becoming a trusted partner for funding and financing entities investing in technology development and financing projects; and
3. **Generating the Foundational Knowledge and “Know How” to meet the CMM Challenges of the Future**, such that when new shortages or supply chain challenges arise they can be rapidly addressed.

Outcome: Foundational capability for the nation to address the CMM challenges of the future.

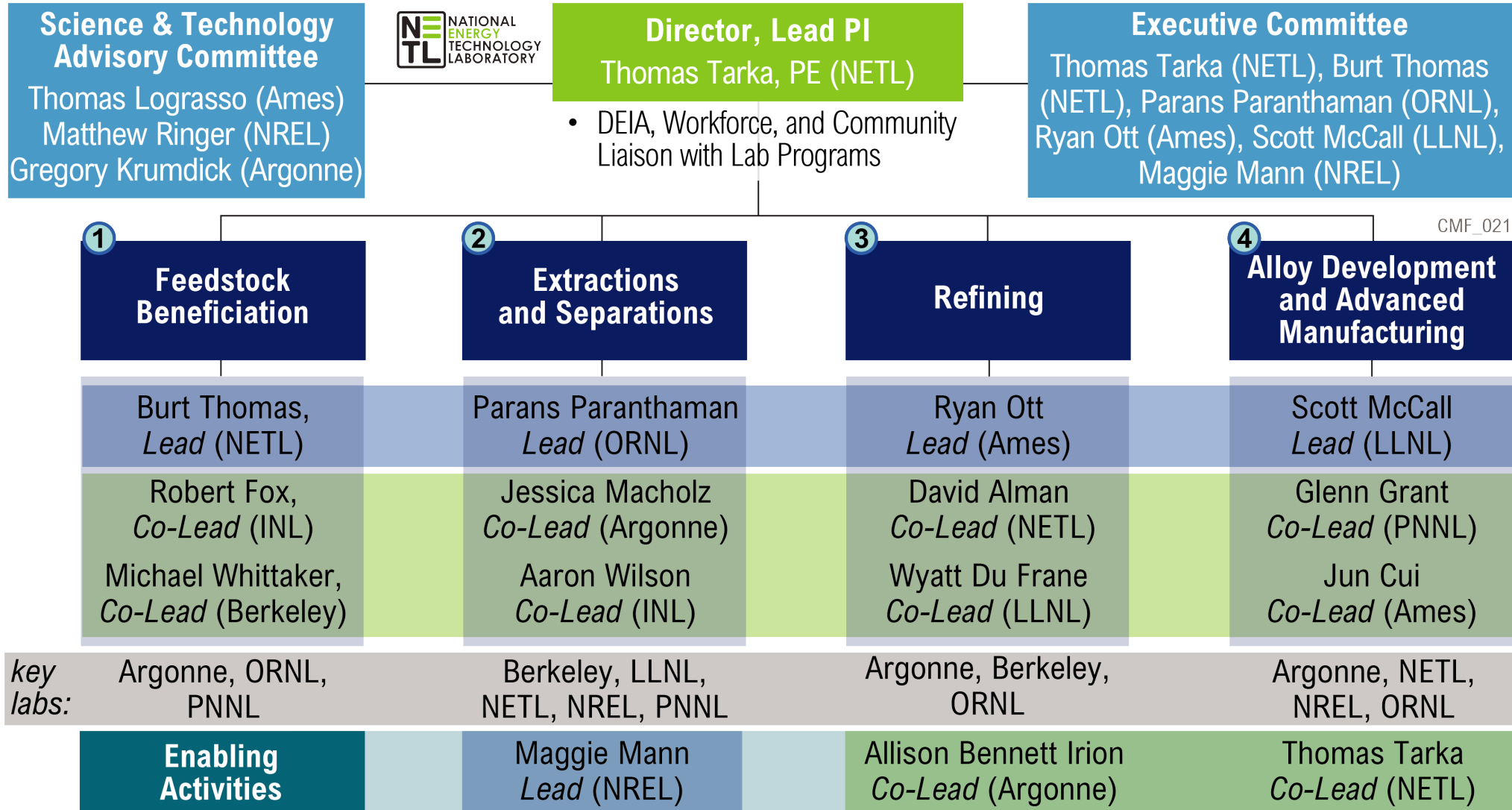
METALLIC: An Innovation Ecosystem



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METALLIC: Organizational Structure



METALLIC: How it Works

METALLIC Innovation Ecosystem

TRL 3 → TRL 4 → TRL 5 → TRL 6+

Center Activity

- Rapidly advance technology from the bench to deployment for commercialization
- Unit operations validation
- Materials and prototype testing and validation
- Perform independent TEA/LCA to understand the impact of proposed technologies

Process Optimization & Modeling

AI/ML Discovery

Secured Data

Outcomes

- De-risk domestic industry adoption of new technologies
- Demonstrate success at various scales
- Accelerate deployment of novel processing technology
- Support establishment of domestic CMM supply chains
- Validated materials
- Working prototypes
- Prepared feedstocks/materials

Academia
Resource Owners
Manufacturers
FOA Awardees
R&D Users

Technologies

Feedstocks

*Alloys &
Materials*

*Expert- and model-
informed innovation*

Enabling Efforts



eXtremeMAT



GREET®

METALLIC: Project Benefits



Establishing a National Capability

- **Provides a Structure and Forum for Nation's Leading CMM Researchers and Scale-up Experts to Collaborate**
- **Leveraging & Expanding Upon Existing Capabilities Results in a Broader, Bigger Impact**
- **Establishes an "Innovation Ecosystem"**
 - Connects RD3 Across Supply Chain Areas
 - Creates Linkage between technology developers and industry/financiers
 - Foments Broad Cross-Pollenization
 - Provides Data for Modeling and Baselineing, Accelerating Model Development
 - Reduces Uncertainty in Performance Metrics
- **Informs Programmatic Decisions and Supports the CMC**

METALLIC: Project Benefits



Establishing a National Capability

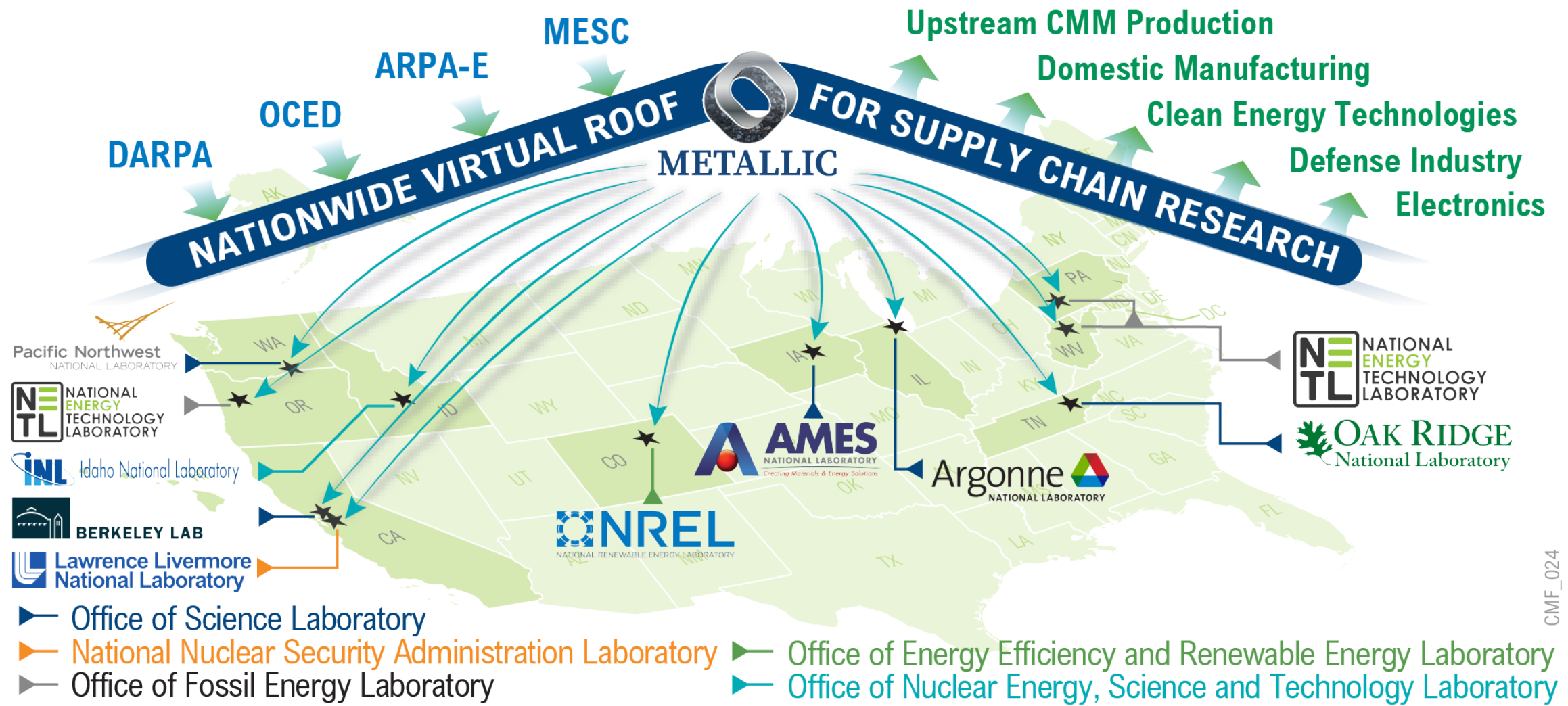
The Bottom Line

- By building the connective tissue between our respective institutions, we are establishing a particularly unique and powerful capability for the Nation
- This can and will transform the development of our domestic supply chains
- These efforts will establish a lasting and foundational capability that allows our nation to meet the CMM challenges of the future and regain our status as innovators in CMM and the products which rely on them

METALLIC: A Federated Research Facility



Supporting U.S. Government & Industry Efforts to Establish CMM Supply Chains



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Questions?

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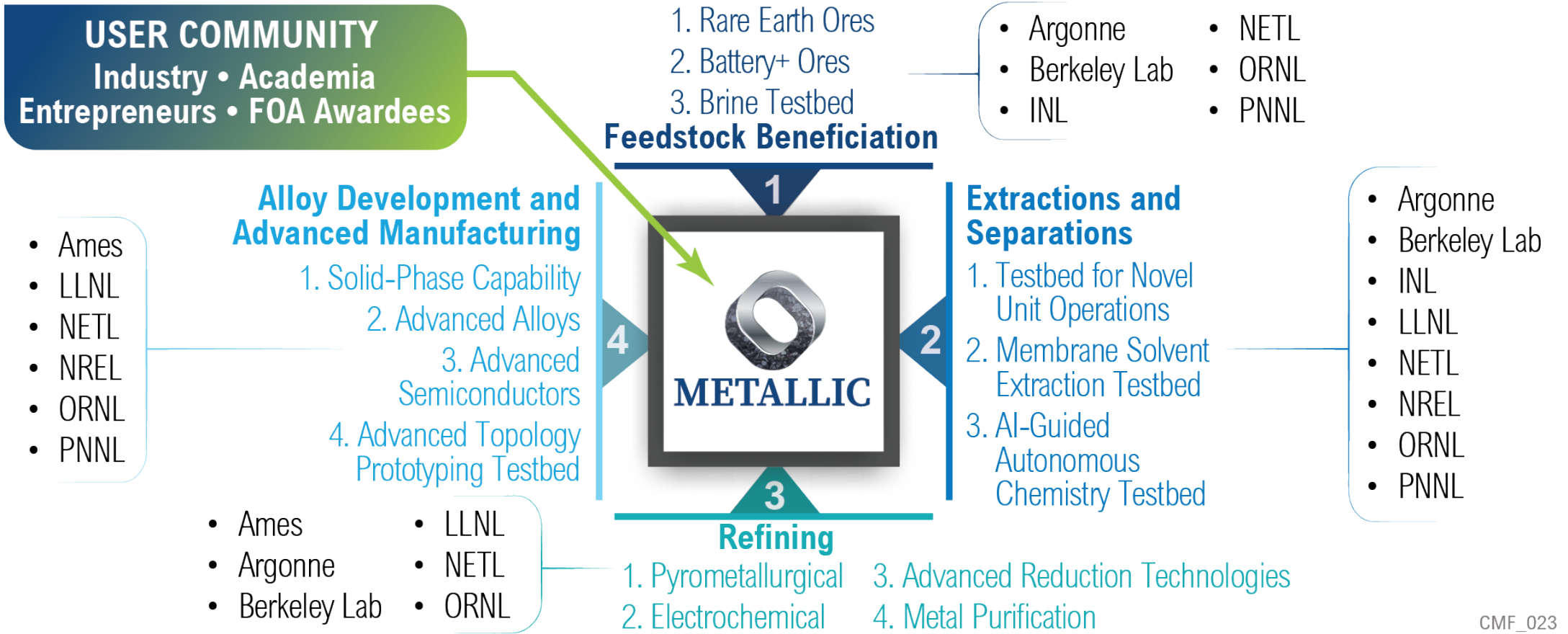
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Thank you for your Attention!



METALLIC: Flagship Activities & Participants



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ENABLING ACTIVITIES

Provide Comprehensive, Independent LCA and TEA Capabilities • Develop Data Warehouse & Interfaces • Connect Analysis with Experimentation • Convene Stakeholders • State of Technology Analysis • TRL/MRL Evaluation

- Argonne
- NETL
- NREL

METALLIC: Breakdown & Scope of Centers

ENABLING ACTIVITIES

Convenes CMM supply chain stakeholders to identify barriers and facilitate engagement with METALLIC activities • Integrates process modeling and optimization, AI/ML, LCA, TEA, and supply chain analysis to inform experiments and designs, improve simulations and de-risk novel processes to enable rapid industry adoption • Establishes research priorities and performance metrics by securing and sharing data generated during testing across the innovation ecosystem.

Center 1: Feedstock Beneficiation

- Long-term benefits to domestic industry and national security:
- Enables stakeholders to testbed improvements in pre-processing and beneficiation approaches that improve performance and lower cost and energy requirements
 - Enables mineral recovery from energy process streams by developing field-deployable brine testbeds
 - Speeds up domestic development by accruing and applying mineral resource knowledge necessary to apply predictive modeling

Center 2: Extractions and Separations

- Provides mid-scale facilities for extractions and separations to de-risk technologies at relevant scales:
- Accelerates transition from technology demonstration to commercialization by providing capabilities and expertise that are not readily available
 - Enables stakeholders to develop and demonstrate pre-pilot scale processing of critical materials
 - Provides a wide range of methodologies for materials flexibility and maximizes compatibility with processing approaches unique to specific supply chain requirements

Center 3: Refining

- Provides pre-pilot scale refining by using a wide range of technologies:
- Provides refining capabilities that offer lower-cost, reduced energy intensity, and reduced environmental impact
 - Creates flagship activities that have capabilities integrated with advanced diagnostics and data analytics to enable real-time process monitoring and control
 - Works with stakeholders to develop commercially scalable solutions to fill technology and capability gaps

Center 4: Alloy Development and Advanced Manufacturing

- Accelerates development timeline of novel technologies:
- Provides capabilities to advance processing technologies from the laboratory bench-top to pre-pilot and pilot scales
 - Accelerates the pace of innovation by improving modeling system capabilities and informing future RDD&D efforts with data collected across the innovation ecosystem
 - Enables process scaling and optimization through advanced diagnostics and in situ material characterization

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METALLIC: Project Goals



A Broad Approach to a Broad Problem

At Completion, METALLIC will provide:

Configurable testbeds as a resource for accelerating development & validation of novel technologies across the entire supply chain, with validation at emerging and industry-relevant scales and modeling capabilities that reduce research timelines, cost, and risk to create a high-impact, enduring capability.

It will integrate capabilities from nine NLs to address gaps in CMM supply chains and the nation's research and validation capability to provide a flexible, foundational capability for addressing the challenges of today and those that emerge in the future.

Furthermore, METALLIC will ensure equitable community impacts and engagement and will foster academic and professional innovation engines.