

# Overview: Critical Minerals & Materials



Photo by Peggy Greb, USDA-ARS

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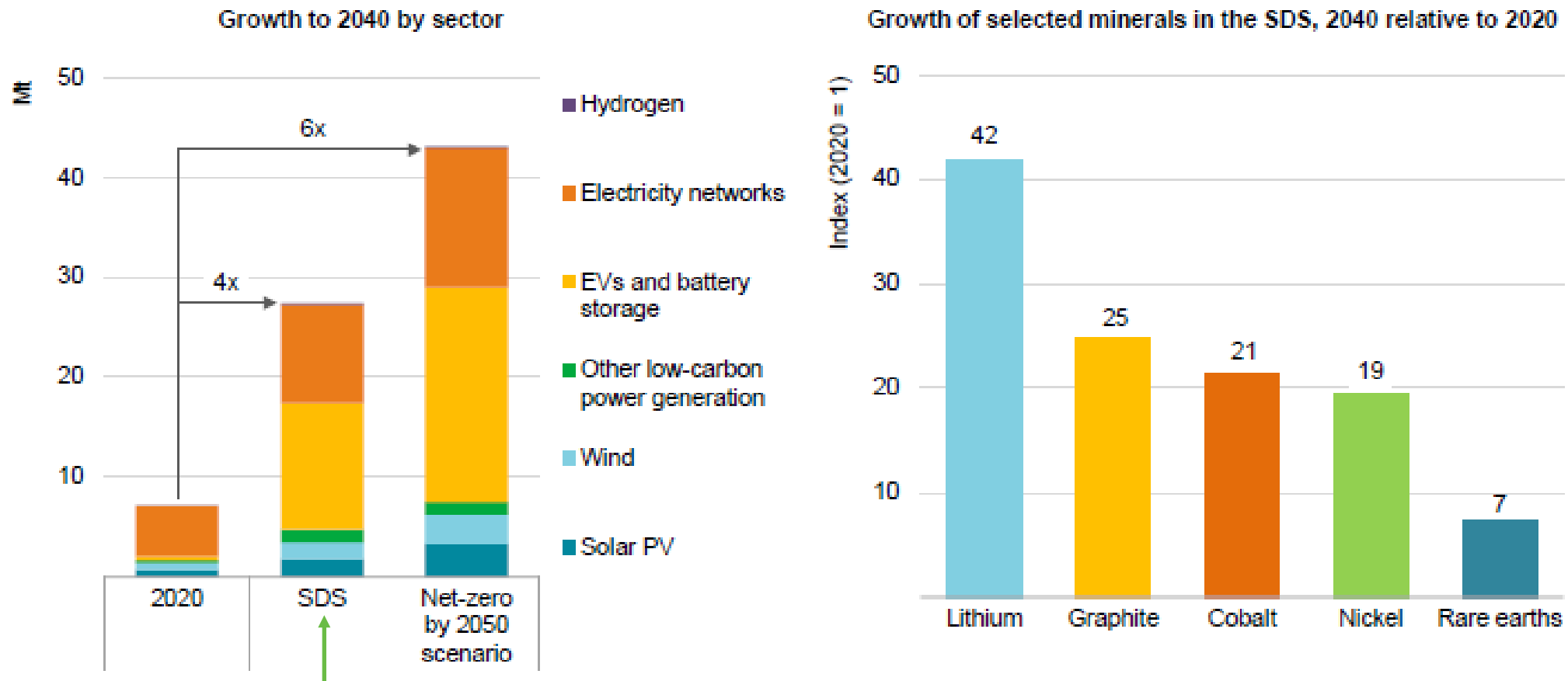
**July 19, 2022**

- Background on Critical Minerals & Materials
- DOE Vision & Strategy
- DOE's Research Portfolio: Now & Future
- Goals for Today's Discussions

# Critical Materials Demand Driven by Decarbonization Goals

- Reduce net greenhouse gas (GHG) emissions 50-52% below 2005 levels by 2035
- Achieve net zero emissions economy-wide by 2050

Mineral demand for clean energy technologies by scenario



Sustainable Development Scenario = SDS

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Notes: Mt = million tonnes. Includes all minerals in the scope of this report, but does not include steel and aluminium. See Annex for a full list of minerals.

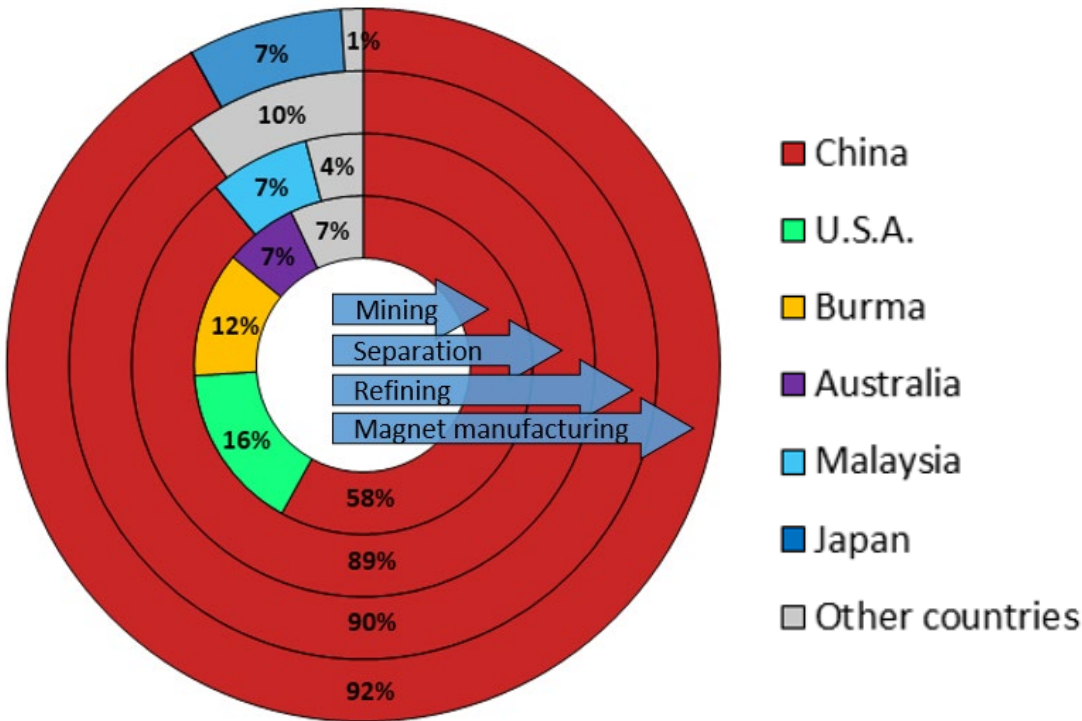
Source: [IEA](#)

# Critical Mineral and Material Supply Chain Vulnerabilities

## Supply Chain Vulnerabilities

- Up-to-mid stream capabilities **are concentrated in 1-3 countries**
- **Lack of midstream capabilities are a gap** that limit growth of upstream supply and downstream value-add manufacturing

Example: Geographic concentration of supply chain stages for sintered NdFeB magnets



### Upstream

Mining, Extraction & Concentration

### Midstream

Refining & Component Manufacturing

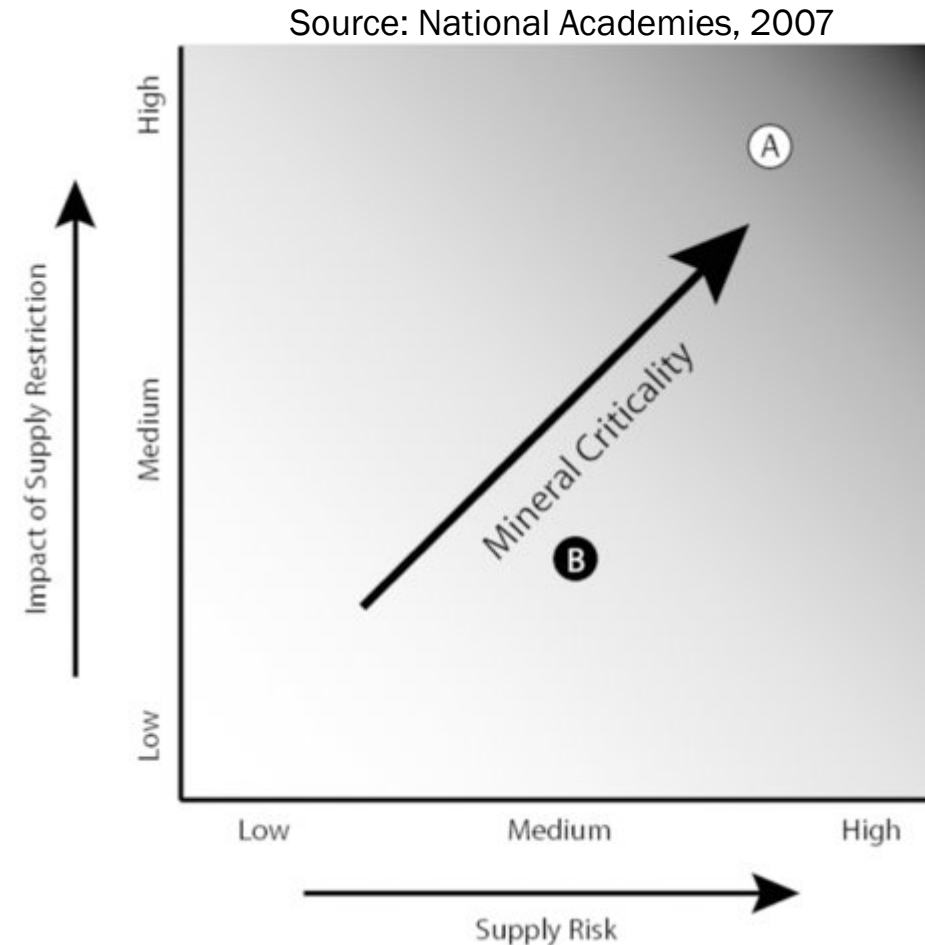
### Downstream

Manufacturing

Reuse/Recycle

# What is a Critical Material or Mineral?

- Critical **Material**:
  - any non-fuel mineral, element, substance, or material that the Secretary of Energy determines—
    - has a **high risk of a supply chain disruption**; and
    - serves an **essential function in one or more energy technologies**, including technologies that produce, transmit, store, and conserve energy; or
  - a critical mineral.
- Critical Mineral:
  - any mineral, element, substance, or material designated as critical by the Secretary of Interior (Federal List of CMs)
  - Exclusions: fuel minerals; water, ice or snow; common varieties of sand, gravel, pumice, cinder and clay
  - [USGS 2022 Critical Minerals List](#)
  - [USGS 2021 Open File Report](#) (methodology)

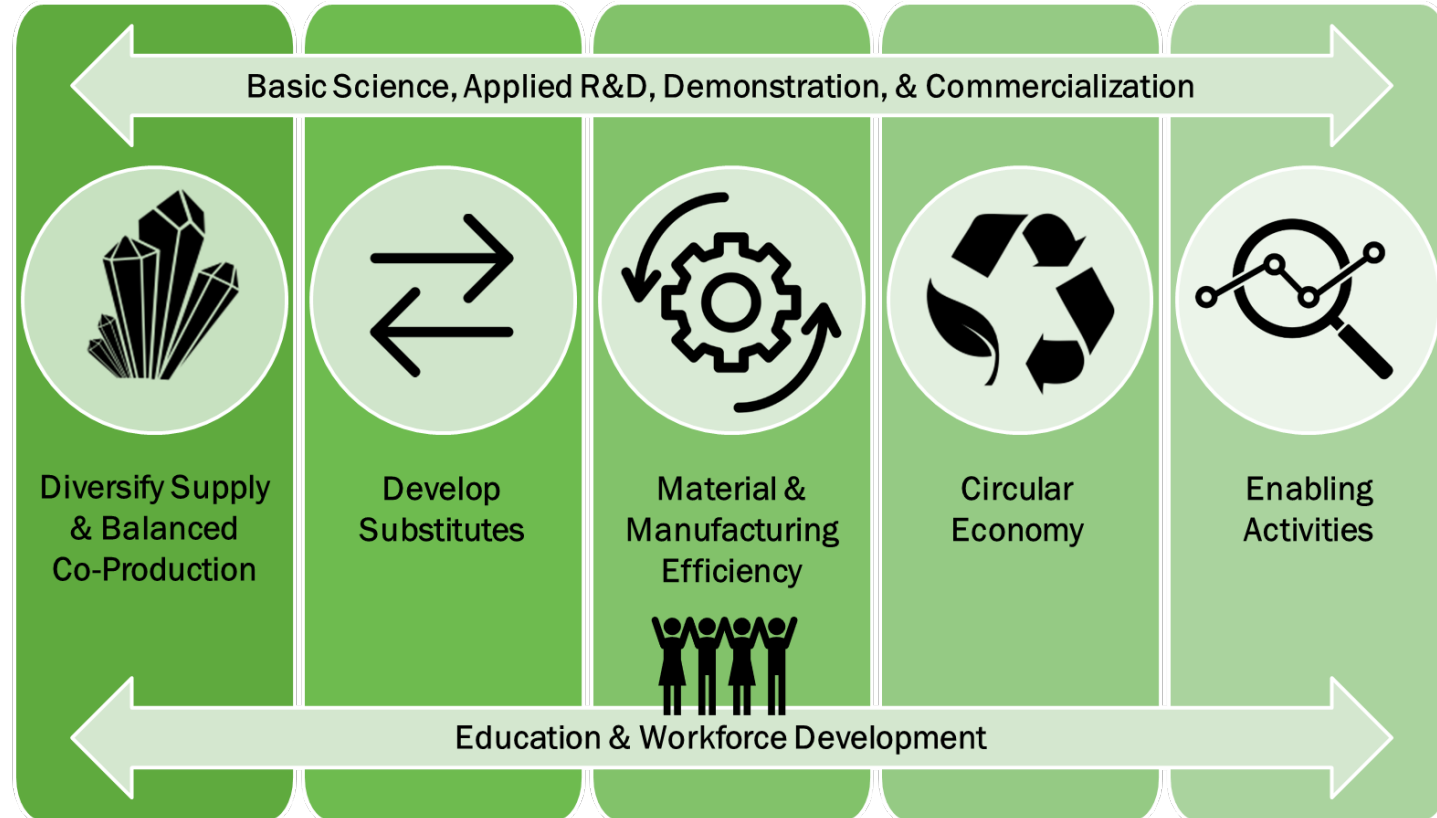


→DOE will be updating criticality assessment to inform future priorities.

# DOE Critical Minerals and Materials (CMM) Vision & Strategy

**Vision:** Resilient, diverse, sustainable, and secure domestic critical mineral and materials supply chains that support the clean energy transition and decarbonization of the energy, manufacturing, and transportation economies while promoting safe, sustainable, economic, and environmentally just solutions to meet current and future needs.

## Strategy:



***Requires a Material-by-Material Approach as part of an All-of-Government Strategy***



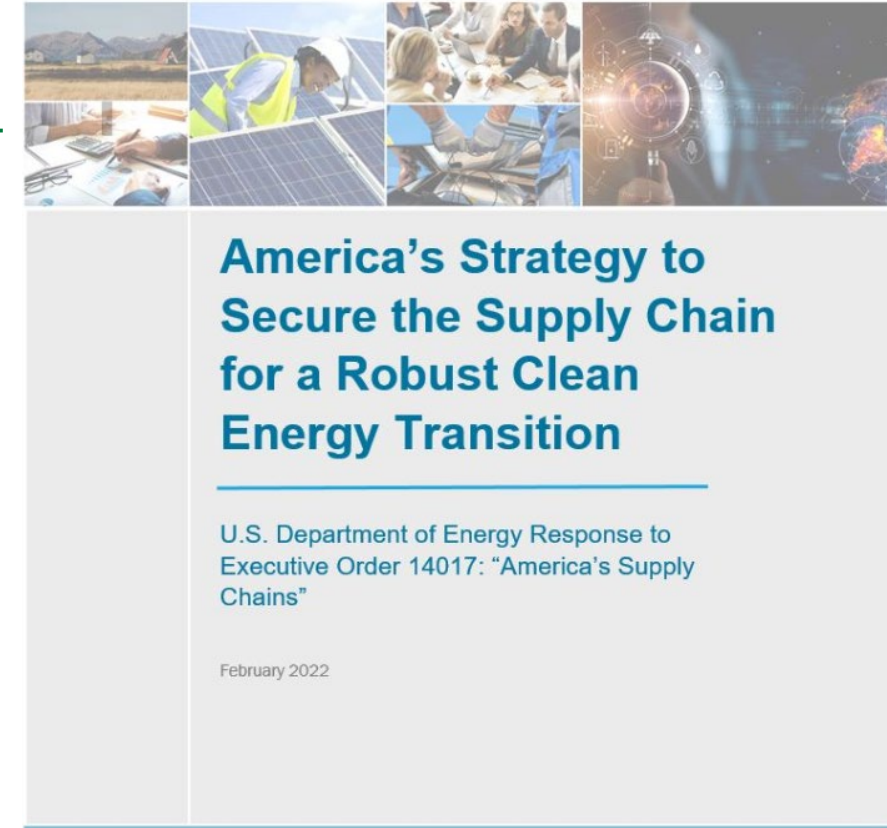
# Role of DOE in the Federal Landscape

- DOE's primary role is to advance research, development, demonstration, and deployment spanning basic science to technology innovation.
  - Supported by analyses, domestic and international standards, and international collaboration with allied countries
- DOE does not have regulatory authority to issue permits for critical minerals or materials activities.
- DOE partners with other federal agencies and departments
  - Implementation of Federal Strategy on Critical Minerals
  - Mining Reform
  - National Blueprint for Lithium Batteries



# DOE CMM Strategy in Action

- DOE is working to secure and strengthen the critical minerals and materials supply chain:
  - Published “[America’s Strategy to Secure the Supply Chain for a Robust Clean Energy Transition](#)”
  - Ongoing basic and applied research, development, and demonstration activities that span the entire supply chain
  - Expansion to commercialization/deployment activities
    - Implementation of the Infrastructure Investment and Jobs Act
  - Critical mineral stockpile for the clean energy economy
  - Bilateral and multilateral cooperation with allied partners
  - Standards to promote supply chain transparency and traceability





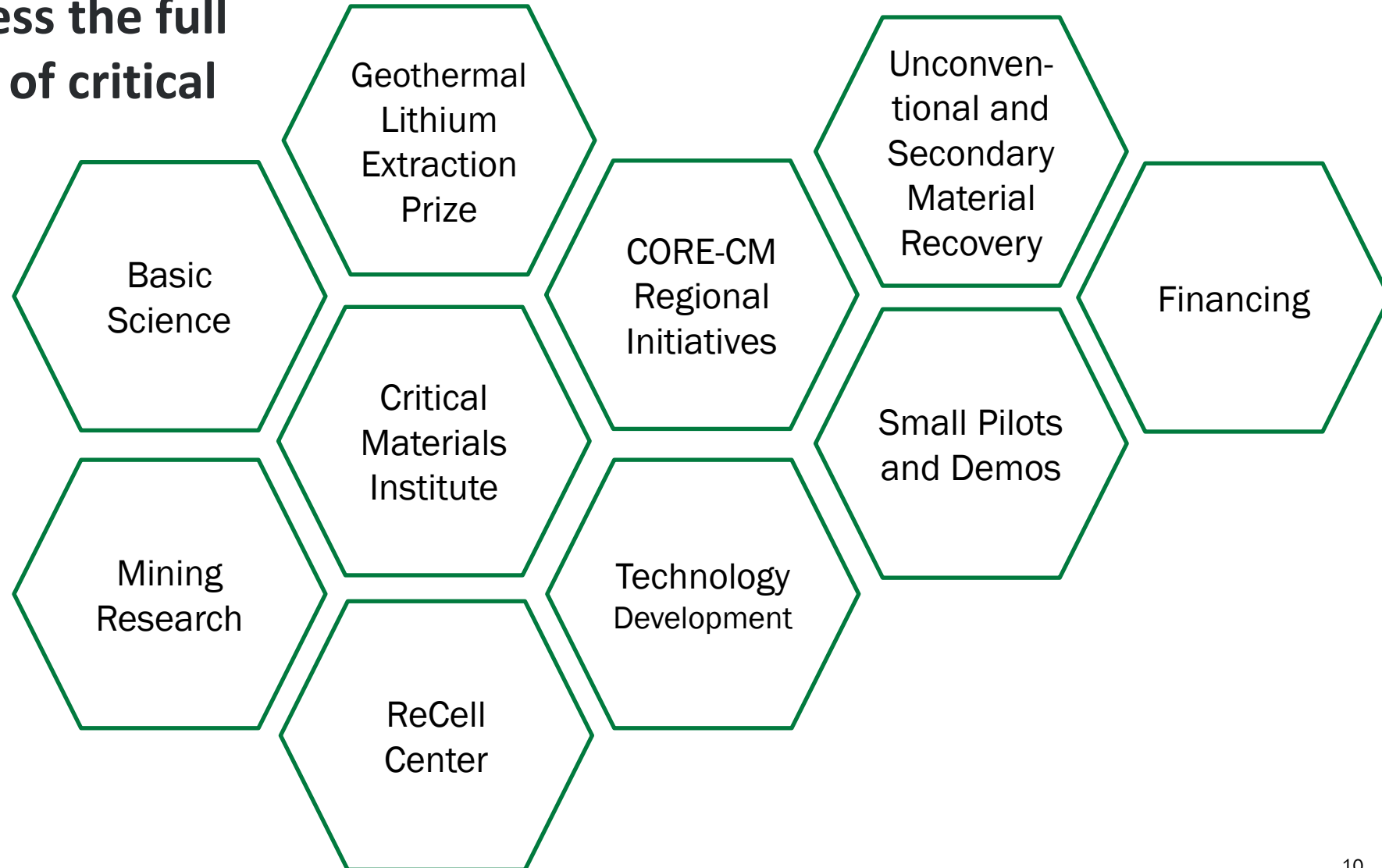
# Justice40 Initiative and Environmental & Energy Justice



- **Justice40 Initiative** – Created by E.O. 14008, establishes a goal that **40% of the overall benefits of certain federal investments flow to disadvantaged communities (DACs)**.
  - Investments in climate change
  - Clean energy and energy efficiency
  - Clean transit; affordable and sustainable housing
  - Training and workforce development
  - Remediation and reduction of legacy pollution
  - Development of critical clean water infrastructure
- **Environmental Justice** – The fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.
- **Energy Justice** – Refers to the goal of achieving equity in both the social and economic participation in the energy system, while also remediating social, economic, and health burdens on those disproportionately harmed by the energy system.

# DOE Critical Minerals & Materials Activities

DOE's core activities span multiple Program Offices and address the full supply chain and life cycle of critical minerals and materials



# DOE Lithium Battery Workforce Initiative



- DOE launched the national [workforce development strategy](#) for lithium-battery manufacturing in partnership with the Department of Labor, and AFL-CIO
  - Five pilot training programs in energy and automotive communities
  - Partnerships between industry and labor

# Recent, Active, and Upcoming Opportunities

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- Request for Information: [BIL SECTION 41001 ENERGY STORAGE DEMONSTRATION PROJECTS](#)
- Notice of Intent: [Vehicle Technologies Office Program Wide Funding Opportunity Announcement](#)
- Notice of Intent: [BIL SECTION 40314 REGIONAL CLEAN HYDROGEN HUBS](#)
- Funding Opportunity Announcement: [BIL BATTERY MATERIALS PROCESSING & BATTERY MANUFACTURING](#)
- Funding Opportunity Announcement: [BIL ELECTRIC DRIVE VEHICLE BATTERY RECYCLING AND SECOND LIFE APPLICATIONS](#)
- Request for Information (closed): [BIL Rare Earth Element Demonstration Facility](#)
- Request for Information (upcoming): Critical Materials RDD&CA Program including BIL SECTIONS 41003c & 41003d

# DOE Critical Materials Research Program

- DOE budget request in fiscal year 2023 nearly doubles critical minerals and materials research.

	Diversify Supply	Develop Substitutes	Material & Mnfg. Efficiency	Circular Economy	Enabling Activities
Basic Science	DOE's existing research program spans 6 Program Offices, totaling \$217M in FY2021. DOE's budget request in FY2023 for CMM totals \$400M.				
Applied R&D					
Pilots					
Demos					
Commercialization					

# DOE Critical Materials Research Program

- The Infrastructure, Investments and Jobs Act, also commonly known as the Bipartisan Infrastructure Law (BIL), will expand ongoing activities.

	Diversify Supply	Develop Substitutes	Material & Mnfg. Efficiency	Circular Economy	Enabling Activities
Basic Science	<b>Energy Act of 2020:</b> Authorizes Critical Materials Research, Development, Demonstration, and Commercialization (RDD&CA) Program, including a Critical Materials Consortium. Also authorizes a Critical Material Supply Chain Research Facility				
Applied R&D					
Pilots					
Demos					
Commercialization					

**BIL 41003c:** \$600M for Critical Materials Innovation, Efficiency, and Alternatives.  
**BIL 41003d:** \$75M for a Critical Material Supply Chain Research Facility



# DOE Critical Materials Research Program

- DOE will integrate activities across as part of Critical Materials Research, Development, Demonstration, and Commercialization Program (RDD&CA).

	Diversify Supply	Develop Substitutes	Material & Mnfg. Efficiency	Circular Economy	Enabling Activities
Basic Science	<u>Critical Materials Research, Development, Demonstration, and Commercialization Program (RDD&amp;CA)</u> <ul style="list-style-type: none"><li>• Yearly appropriations – existing and planned activities</li><li>• New authorizations from Energy Act of 2020</li><li>• New funding from BIL 41003c/d</li><li>• Coordinated with other BIL funded activities</li></ul>				
Applied R&D					
Pilots					
Demos					
Commercialization					

# Material-by-Material Approach Driven by Decarbonization Goals

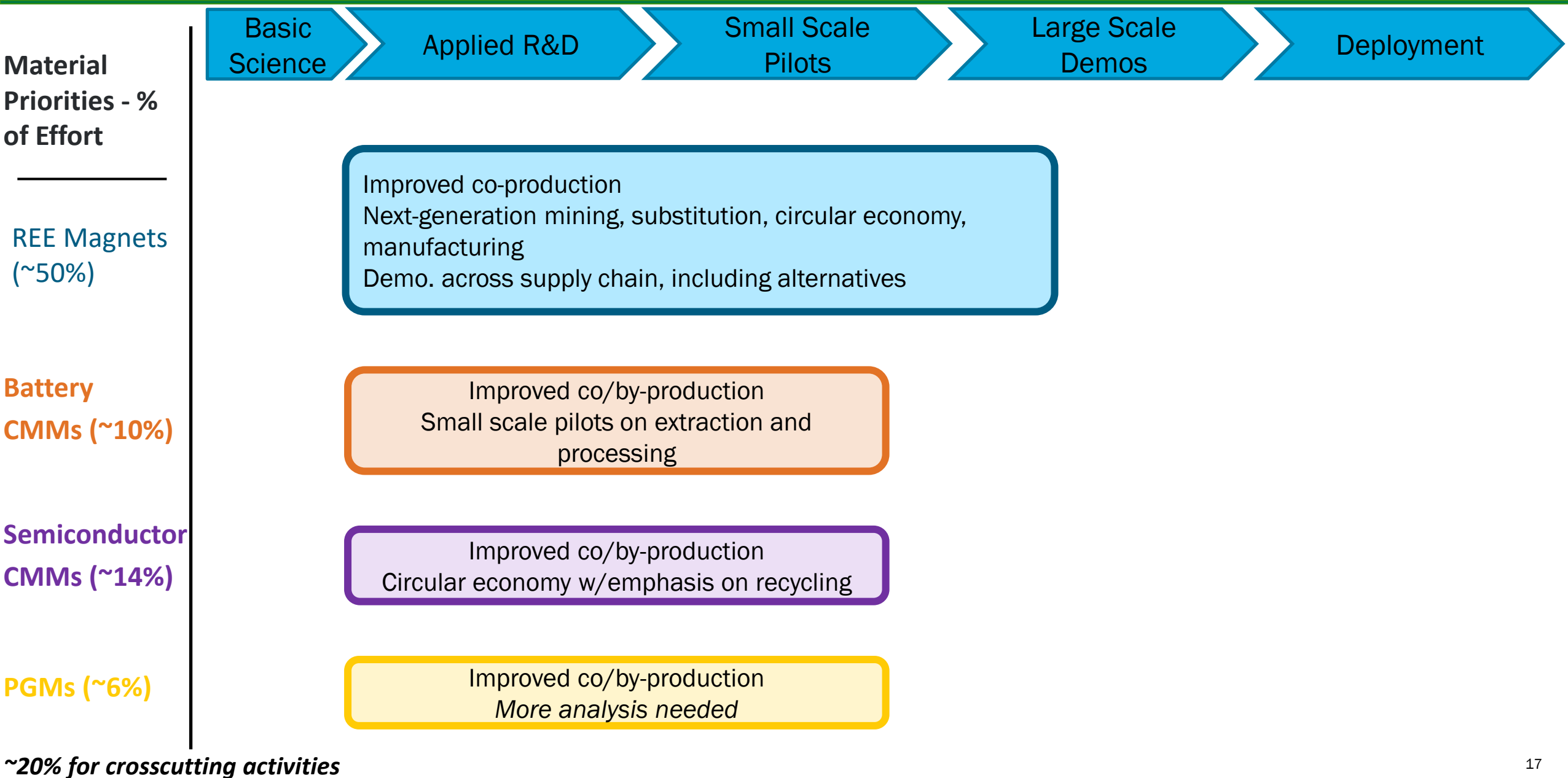
GOALS

- 100% clean electricity by 2035: 30 GW offshore wind by 2030 •
- Zero-emission transportation: 50% EV adoption by 2030 •

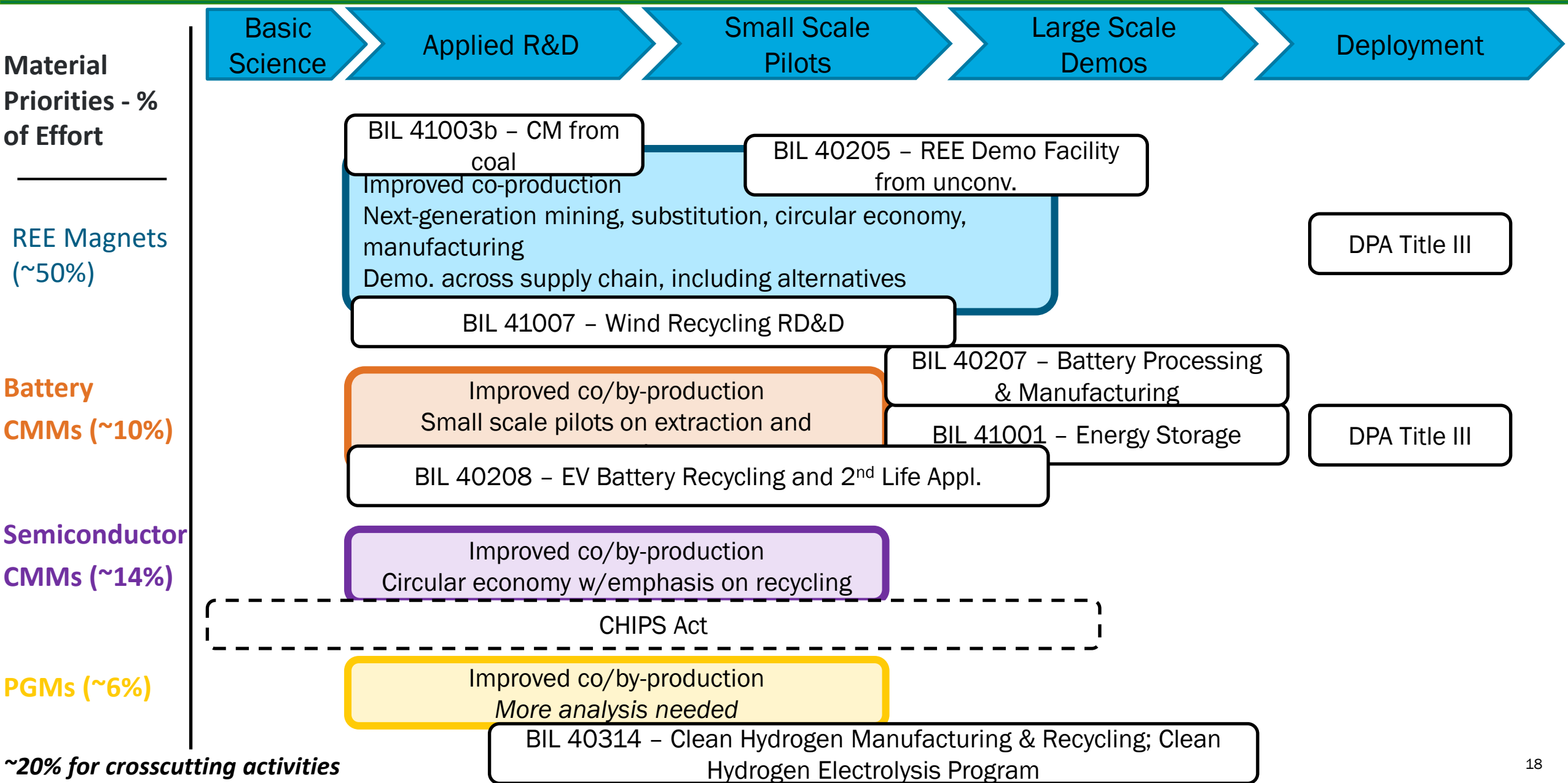
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|---|---|---|
| • Neodymium, Praseodymium, and Dysprosium for magnets                 | → | Magnets enable efficient electric machines including wind generators, electric and fuel cell vehicle motors, industrial motors  |
| • Lithium, Cobalt, Nickel, Manganese, and Graphite for energy storage | → | Batteries are needed for electric vehicles and grid storage to enable high penetration of zero-emission transportation and intermittent clean power generation                                      |
| • Iridium & Platinum for electrolyzers; Platinum for fuel cells       | → | Iridium and platinum for electrolyzers are needed for green hydrogen production and platinum for fuel cells used in transportation and stationary energy storage                                    |
| • Gallium for wide bandgap semiconductors, LEDs                       | → | Wide bandgap power electronics enable high voltage power generation (like wind) to connect to the grid  |
| • Germanium for microchips (semiconductors)                           | → | Microchips for sensors, data, and control play an important role in SMART manufacturing, which will be needed to increase efficiency and minimize waste (inclusion GHGs); Fiber and infrared optics |

America's Strategy to Secure the Supply Chain for a Robust Clean Energy Transition

# Priorities for Critical Materials RD&D



# Priorities for Critical Materials RD&D



# Critical Materials Consortium & Supply Chain Research Facility

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## Critical Materials Consortium

- Centralized entity for multidisciplinary, collaborative, critical materials R&D to support the Critical Materials Research Program
- Membership – Federal agencies, national laboratories, National Minerals Information Center, institutions of higher education, private sector entities, multi-institutional collaborations, and other appropriate entities

## Critical Material Supply Chain Research Facility

- Enable the Critical Materials Research Program throughout the supply chain for critical materials
- Provide an integrated, rapidly reconfigurable research platform

# Goals for Consortium and Supply Chain Research Facility

- Create an integrated innovation ecosystem to advance environmentally responsible and cost-competitive recovery, material, process, and manufacturing advancements.
- Advance next-generation technologies to meet mid-to-long term needs of the clean energy industrial base, informed by ongoing criticality assessment.
- Contribute to accelerated technology transition and deployment to meet near-term goals for the domestic clean energy supply chain needs by de-risking innovative technologies at an industrially relevant scale.
- Support crosscutting analysis and modelling work to enable rapid innovation.





# Goals for Today

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- DOE is in listening mode! We want to hear your ideas and concerns.
- Three breakout discussions:
  1. Research priorities for the Critical Materials RDD&CA Program including education and workforce development
  2. Implementation of a Critical Materials Consortium
  3. Implementation of a Critical Material Supply Chain Research Facility
- Continued stakeholder engagement throughout the process of development and implementation
  - A Request for Information (RFI) is planned for release mid-to-late July
  - Your input will be considered for DOE planning purposes and funding opportunities

**Thank you for your attention!**