CMI

Accelerating Energy Innovations

Critical Materials Institute

AN ENERGY INNOVATION HUB

Advanced Recovery, Inc. · CYTEC · GE · Molycorp · OLI Systems, Inc. · SIMBOL materials

Colorado School of Mines · Brown · Iowa State University · FIPR · Purdue University · Rutgers · UC Davis

The Ames Laboratory · Oak Ridge National Laboratory · INL · Lawrence Livermore National Laboratory

U.S. DEPARTMENT OF ENERGY

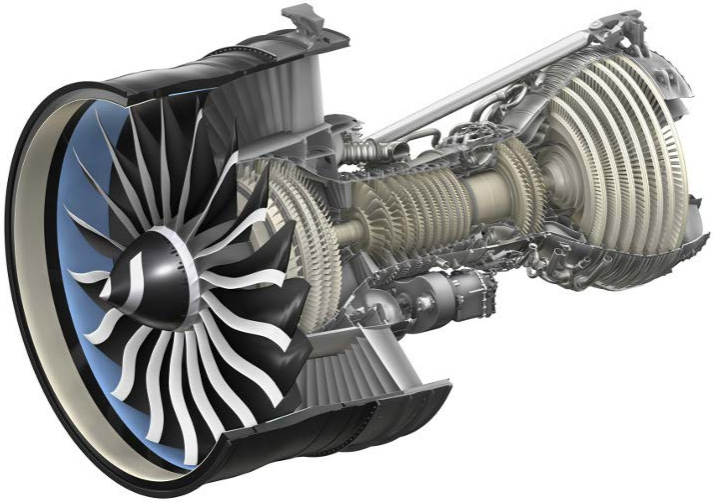
- Complexity begets vulnerability -

~30 elements

~65 elements

Materials criticality is affecting us *today*

- Jet engine manufacturers, including CMI partner GE, have had to deal with shortages of rhenium.
  - http://www.gereports.com/engineering-ways-to-reduce-the-rare-metal-rhenium-in-jets/



- A major disk-drive manufacturer came within one week of shutting down production for lack of Nd-Fe-B magnets.

Materials criticality is affecting us *today*

- Loudspeaker manufacturers have been severely impacted by magnet price increases.

- Tesla Motors may be forced to reduce production because of short supplies of Li-ion batteries.
  - http://wheels.blogs.nytimes.com/2013/09/06/as-it-increases-production-tesla-worries-about-battery-supply/?_r=0

Materials criticality is affecting us *today*

- The target date for transition to high-output T5 fluorescent lamps has been delayed by two years because manufacturers claim that there is a shortage of Eu and Tb for the phosphors.

- Utility-scale wind turbine installations are overwhelmingly gearbox-driven units, despite the high failure-rate of the gearboxes, because of the cost and unavailability of Nd and Dy required for direct-drive units.

Most solutions take effect *"tomorrow"*

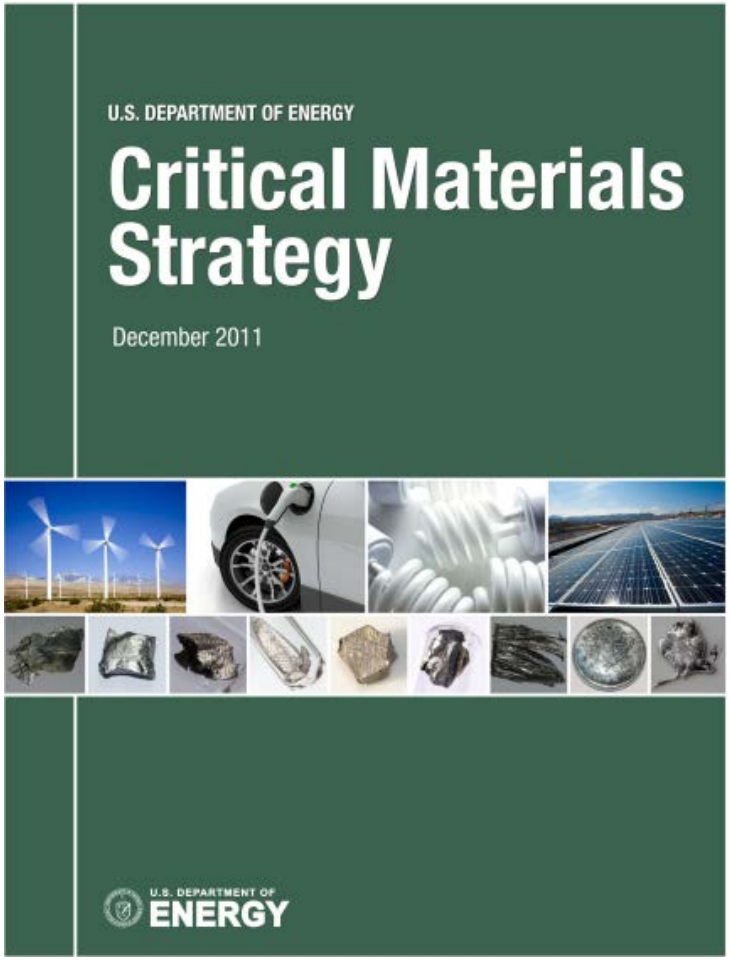
- Mine development, *where there is a known resource*, takes at least 10 years.
- Deployment of substitute materials, *when there is an existing option*, takes an average of 4 years.
- Development and deployment of *new* substitute materials takes an average of 18 years.
  - Nd-Fe-B is a notable counterexample: four years from need to deployment.

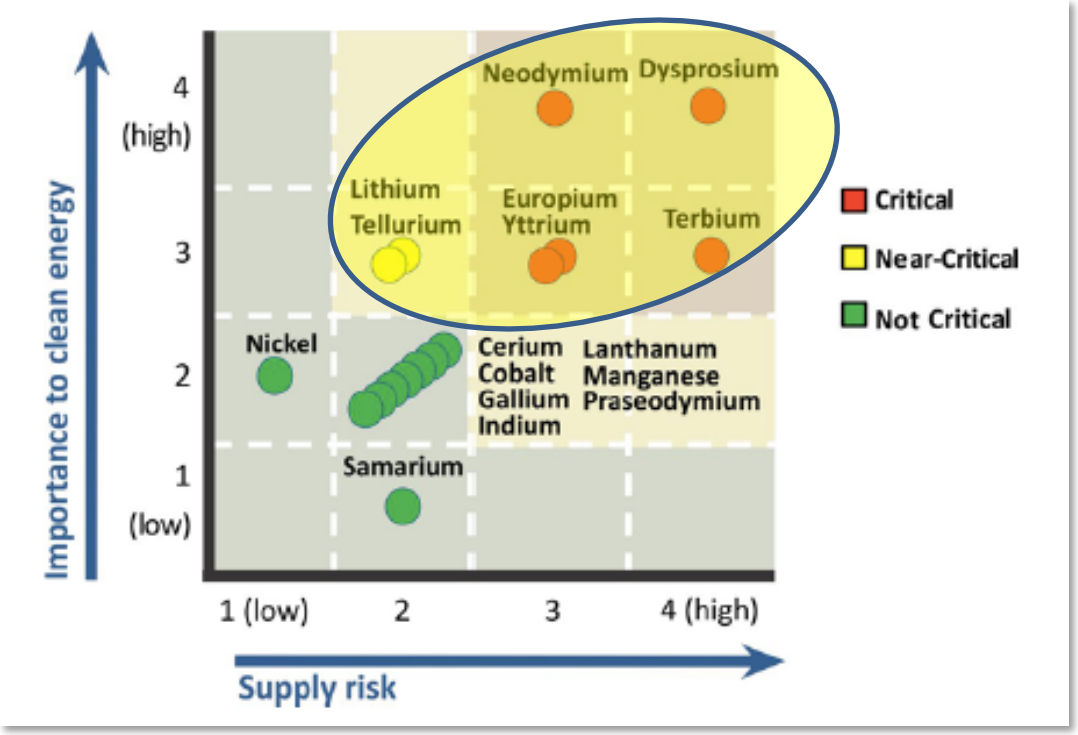
The Bronze Age Collapse

~1200 BC

- Bronze becomes unavailable
  - Possibly because Cyprus is overtaken by war, making copper inaccessible.
- Results
  - Collapse of trade; collapse of power
  - Egypt, finds alternative sources in Africa
  - Eventual emergence of the iron age
- Responses include
  - Recycling
  - Source Diversification
  - Materials Substitution

Pursuing the DOE Critical Material Strategy





Medium Term: 2015 – 2025

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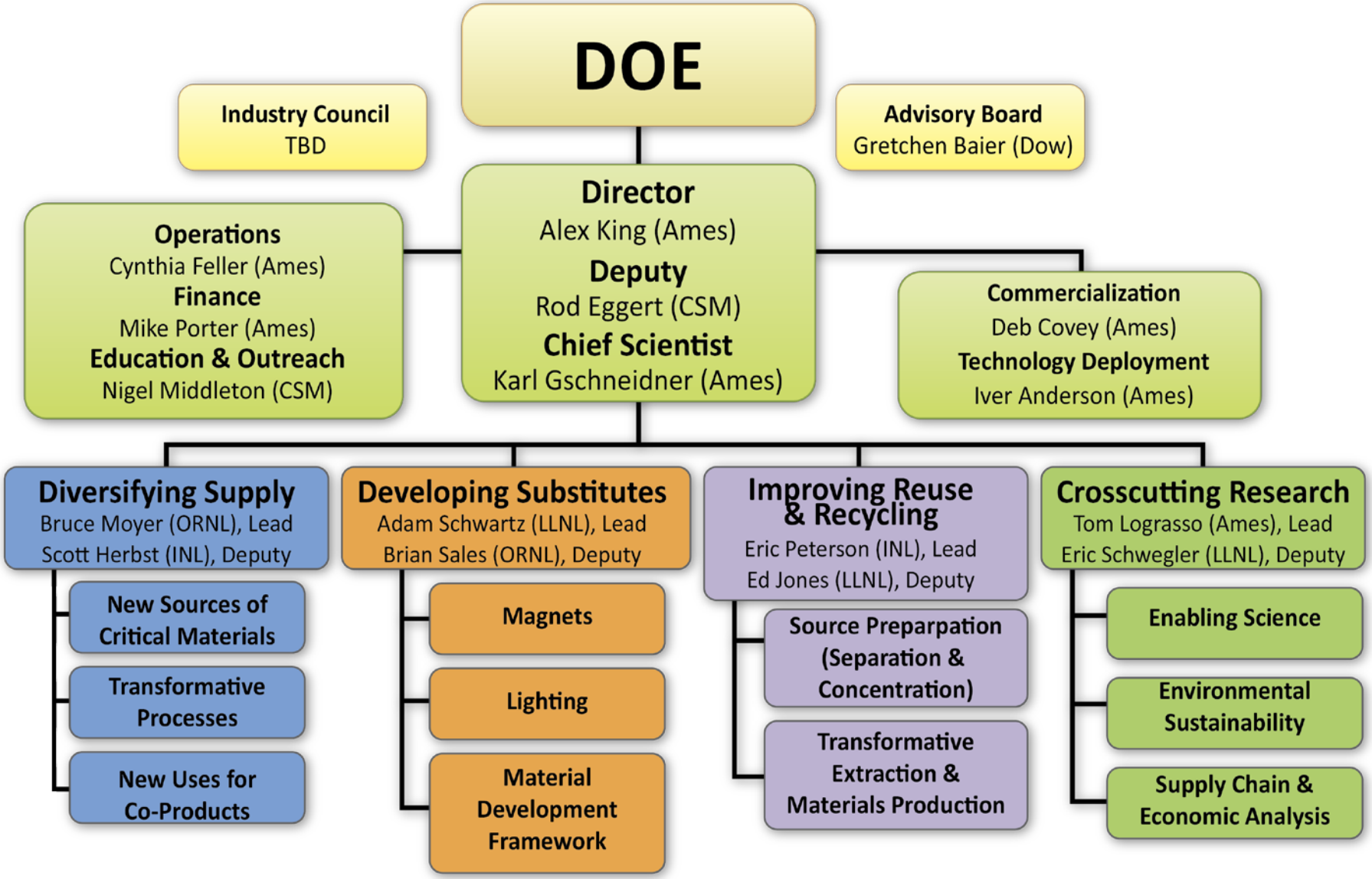
CMI Project Selection and Design

- CMI addresses 7 critical or near-critical chemical elements.
- 35 initial projects, selected for several criteria
  - Potential for impact at a key point in the materials lifecycle, in a realistic timeframe.
  - Integration of strengths and capabilities across the Hub. (No project is carried out by a single partner institution.)
  - Clear path to deployment. Commercialization plan in place on day one.
  - Annual evaluation addresses continued adherence to the timeline and each of the above criteria.
- As the world changes, we expect to terminate projects and start new ones.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