Four CMI Outcomes

• Materials supply chains assured for clean energy manufacturing in the US
  – Current critical materials issues solved
  – Future criticality issues identified and averted

• Supplies of technical talent and expertise assured

• Critical materials information provided to researchers, producers & OEMs

• Federal critical materials research efforts coordinated for maximum impact
Three-D Approach

• Diversify supply

• Develop substitutes

• Drive reuse, recycling, and efficient use of materials in manufacturing

Essentially following DOE’s Critical Materials Strategy, but applying it very selectively

Medium Term Outlooks: 2015 – 2025
Two Guiding Principles

- Produce more
- Use less

- We have to address the entire materials lifecycle, going from birth through death, and beyond, to include resurrection.
One Integrated Team

Critical Materials Institute
Neodymium

• Used for high-performance magnets

• Traditional uses:
  – Hard disk drive spindle motors
  – Portable electronics - loudspeakers & microphones
  – Small motors in vehicles

• Emerging uses:
  – Traction motors in electric vehicles
  – Wind turbine generators
Classical Froth Flotation

- Separates valuable ore from the associated gangue.
- Concentrates bastnaesite, but not monazite.
- Monazite contains more of the higher-value heavy rare earths, but currently goes to the tailings heap.
Quantum Froth Flotation

- **Solution:** find collector molecules that bind monazite to air bubbles.
- Quantum chemistry computations at Ames and Oak Ridge.
- Pilot-scale testing at Idaho.
- US-based chemical manufacturers.
- Deployment to US mines.
Terbium & Europium

• Provide green and red light emission

• Traditional uses:
  – CRTs
  – Long-tube fluorescent lamps
  – Flat panel color displays and TVs

• Current uses:
  – Compact fluorescent lamps
  – Personal electronics

• Future uses:
  – LED lighting
  – OLED displays