

## **Today's agenda**

### **Intro**

Brent Summerville

DWEA SMART Wind Consortium

### **Rare Earth Magnets in Distributed Wind Turbines**

Jim Sims

Vice President Corporate Communications

Molycorp, Inc.



### **Q&A**

### **Recent Developments in Nanostructured Magnetic Materials**

Xing Chen

Nanostructured Materials Group

Energy Systems Division

Argonne National Laboratory



### **Q&A**

## Electrical Subgroup Kickoff Meeting

26 March 2015


Washington DC

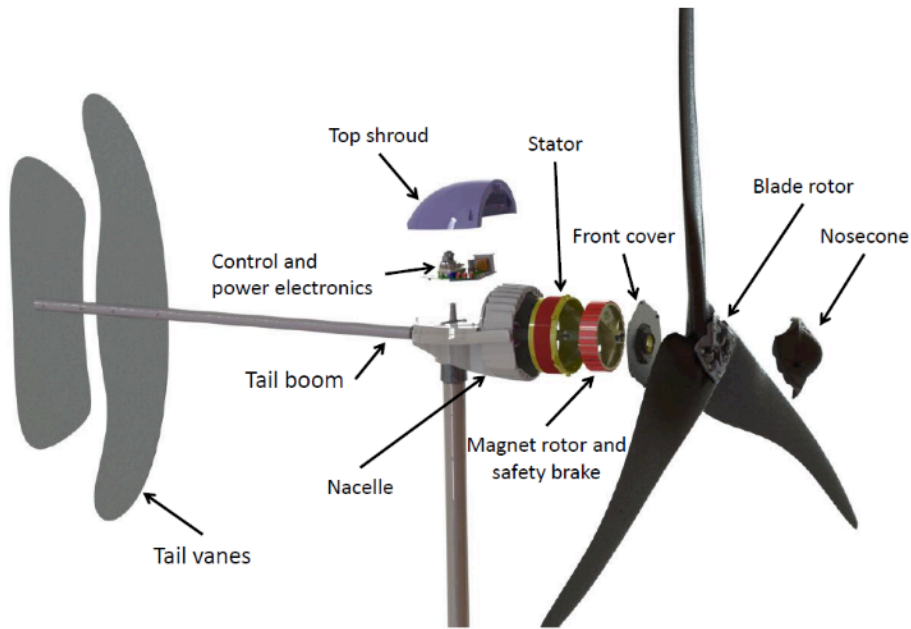
25 in-person

13 virtual

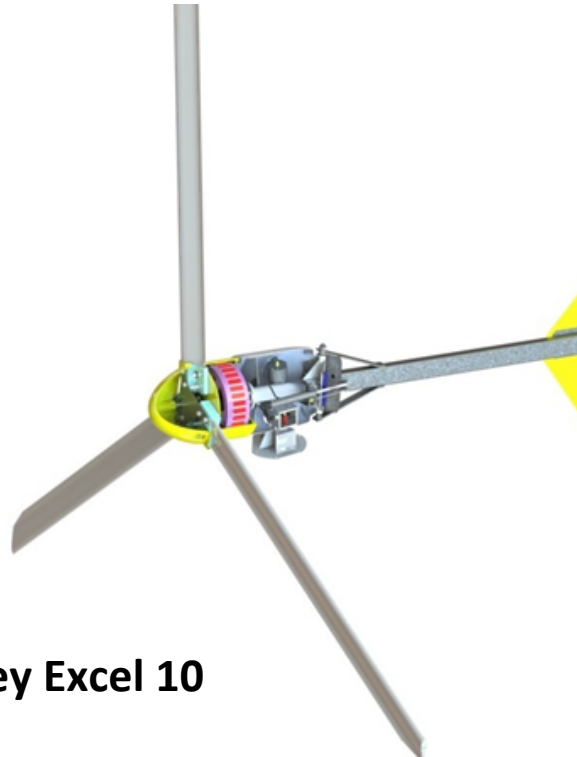


## Virtual meeting topics

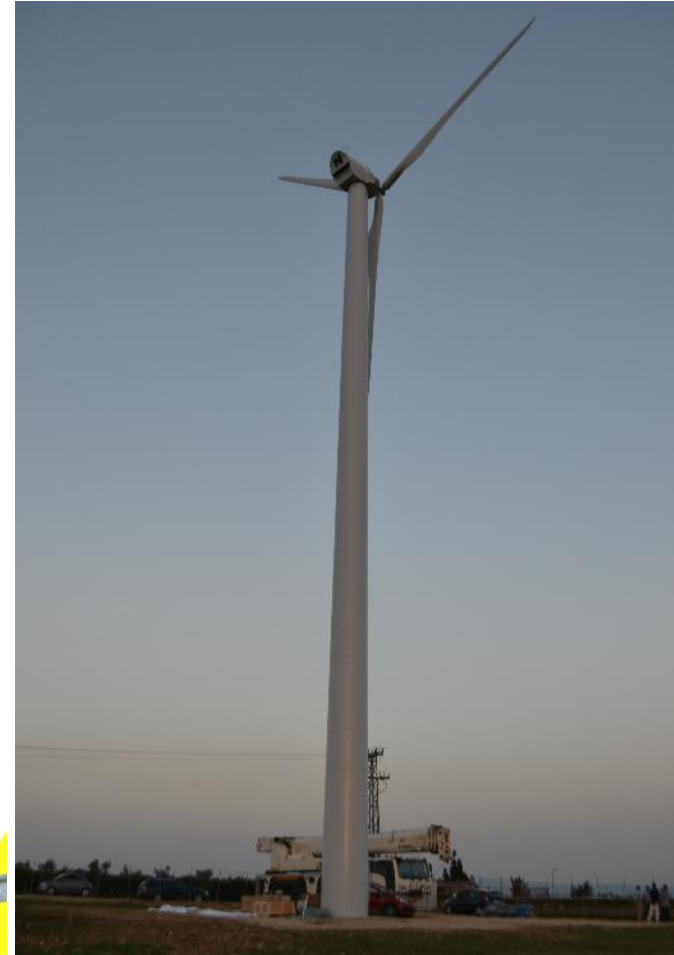
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- **Magnets (Jim Simms, Molycorp), overview of multi-physics simulations (Xing Chen)**
    - includes alternatives to rare earth magnets
  - **Using robotics for coil placement as opposed to custom insertion machine; modern generator manufacturing effort (Dr. Keith Klontz)**
    - Generator is integral part of design, part of load path,
    - Thermal issues different, specialization
    - blades are bolted to rotor in small turbines
  - **Large single-phase inverters for the rural market; VFDs (ask Rob Wills for contacts), SquareD, etc.**
    - Eaton (Trudy has connections)
    - Power One?
    - Schweitzer
  - Power America coordination calls on how to link w/ program, not webinar
  - What have other industries done to standardize their product offerings?
  - Electrical engineer from electrical vehicle industry looking for commonalities and shortcuts (Dr. Ruth Douglas Miller has contact)
    - David Ochs



**Pika T701**



**Bergey Excel 10**



**NPS 100C**



# Ames Laboratory scientists create cheaper magnetic material for cars, wind turbines

## Contacts:

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For release: April 23, 2015

Karl A. Gschneidner and fellow scientists at the U.S. Department of Energy's Ames Laboratory have created a new magnetic alloy that is an alternative to traditional rare-earth permanent magnets.

The new alloy—a potential replacement for high-performance permanent magnets found in automobile engines and wind turbines—eliminates the use of one of the scarcest and costliest rare earth elements, dysprosium, and instead uses cerium, the most abundant rare earth.

The result, an alloy of neodymium, iron and boron co-doped with cerium and cobalt, is a less expensive material with properties that are competitive with traditional sintered magnets containing dysprosium.

Experiments performed at Ames Laboratory by post-doctoral researcher Arjun Pathak, and Mahmud Khan (now at Miami University) demonstrated that the cerium-containing alloy's intrinsic coercivity—the ability of a magnetic material to resist demagnetization—far exceeds that of dysprosium-containing magnets at high temperatures. The materials are at least 20 to 40 percent cheaper than the dysprosium-containing magnets.

"This is quite exciting result; we found that this material works better than anything out there at temperatures above 150° C," said Gschneidner. "It's an important consideration for high-temperature applications."

Previous attempts to use cerium in rare-earth magnets failed because it reduces the Curie temperature—the temperature above which an alloy loses its permanent magnet properties. But the research team discovered that co-doping with cobalt allowed them to substitute cerium for dysprosium without losing desired magnetic properties.

Finding a comparable substitute material is key to reducing manufacturing reliance on dysprosium; the current demand for it far outpaces mining and recycling sources for it.



## Roadmap actions

- Composite magnets, ANL
  - A few years out for commercialization of mags for PE and PMGs
  - Some soft mags for PEs may be available now
    - Si-carbide and soft magnetics contribute to PE costs
    - Passive components (inductors, caps) of inverters and switch gears (contactors, breakers) are significant costs of systems;
      - » Higher freq switching reduces the component size and costs (e.g. soft magnetics)
    - ANL also working on capacitors (thin film, high freq, extending lifetime)
    - Single phase inverters needed in this industry (cost and reliability)
- Rare earth volumes needed to affect some price stability?
  - We are not a Siemens, how can we collaborate as an industry?
  - Molycorp makes the powder, magnet makers make magnets
  - Siemens did a 10-year commitment
  - JS to follow-up on magnet companies that may be interested in smaller volumes for this industry
    - Shin-etsu (Japan; also in Power Elect)
    - Hitachi (sintered RE mags; looking into US manuf, SC?)
    - Companies hold patents on making of the sintered magnets, some challenges there for US manufacturing
  - Action – testing new magnet composites/designs in DW turbines
- Costs
  - What % of system attributed to these rare earth magnet materials? (for PEs and alternators)
- Aimee – send bio/headshot/logo for consortium, website and directory ([agardere@distributedwind.org](mailto:agardere@distributedwind.org))
- Next, May 27, 1pm EDT: Tentative, support structure /mechanical group, lifting and installing