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AMMTO Road mapping Presentation

December 2023

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Changing the World's Energy Future

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AMMTO Road Mapping Workshop

Higher Performance Materials

Higher Performance Materials- Overview

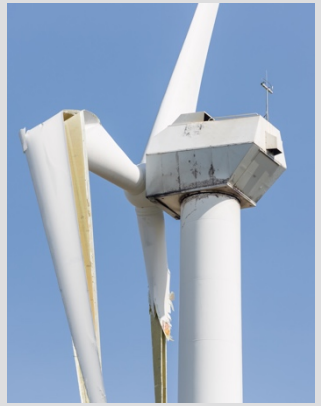
- Higher Performance Materials are Typically Sought to (not an exhaustive list):
  - Access operating conditions that current materials cannot reliably perform in
  - Access or make a new technology viable and ubiquitous
  - Extend the service or usable life of a component or system (e.g., reduced OpEx)
  - Increase operational safety margins
  - Improve component and/or system reliability
  - Increase human survivability in conveyances
  - Increase energy efficiency of systems without degrading operating envelop (e.g., energy conversion, propulsion)
  - Increase environmental sustainability or reduce environmental pollution
  - To miniaturize or reduce the size a component or system

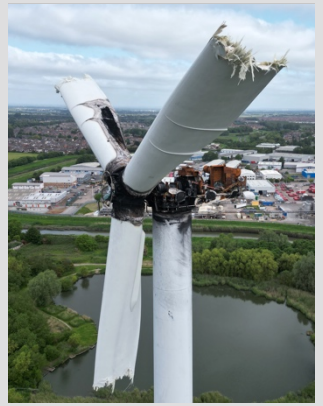
Higher Performance Materials- General Challenges

- Needs/Challenges General to all Areas Include (not an exhaustive list):
  - Advance manufacturing enabling materials and techniques (including scale-up)
  - Industrial decarbonization of manufacturing technologies/techniques
  - Advanced materials joining
  - Rapid prototyping
  - Advanced embedded sensors and diagnostics
  - Prototypical testing of AM components
  - Infrastructural, computational (e.g., ICME) and other enabling tools to support new materials development
  - Materials qualification, including development of new testing protocols
  - Inspection techniques for new materials- at production, installation and during service
  - Workforce development
  - Stakeholder that must be engaged from inception in materials development and qualification

Wind and Hydro

- Some areas of need include:
  - Cheaper, higher corrosion and wear resistant materials and coatings
  - Lightweight composite materials with improved strength/stiffness-weight ratios
  - Erosion and Cavitation resistant materials



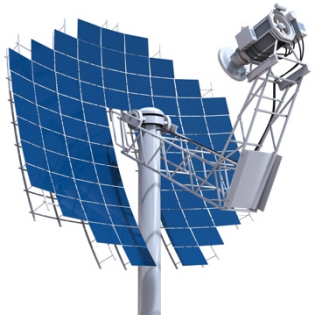


Corroded turbine blade

Solar

Power Plant

Collecting Tower



Dish Stirling

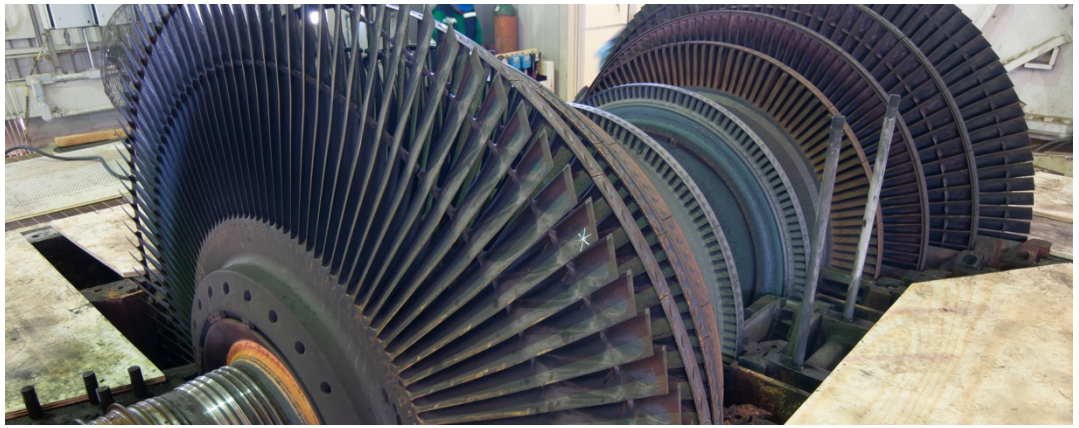
- Some areas of need include:
  - Cheap higher temperature, creep/flow resistant materials with higher strength, lighter weight and superior oxidation resistance (CSP Gen III and beyond)
  - Advanced materials for thermal energy storage and waste heat recovery

Nuclear

- Some areas of need include:
  - Higher temperature, creep/flow resistant materials with higher strength, lighter weight and superior oxidation resistance (e.g., SCC)
  - Durable, accident tolerant, low chemical reactivity, improved radiation-resistant phase-stable fuel cladding materials
  - Advanced radiation resistant materials
  - Advanced fuels
  - Advanced materials for thermal energy storage and waste heat recovery
  - Nuclear fusion enabling materials

Render of stress cracking

Geothermal



Geothermal Power Generator

PDC drilling bit

Tri-cone roller bit

- Some areas of need include:
  - Cheaper corrosion and wear resistant materials for geothermal turbomachinery (e.g., resistant to extreme pH, H_2S attack, fatigue, SCC, IGA)
  - Materials for drilling geothermal wells
  - Advanced materials for thermal energy storage and waste heat recovery

Energy Storage

- Some areas of need include:
  - Better Performing Anode Materials
  - Advanced materials for thermal energy storage and waste heat recovery
  - Hydrogen storage enabling materials

Battery Power Plant

Higher Performance Materials- Pertinent Questions

- Should challenges be resolved, what is the likely impact on energy production, utilization and efficiency?
- How and why will resolving the highlighted R&D challenges (related to higher performing materials) contribute to achieving DOE goals across industries and applications?
- What is the optimal timeframe for solving each highlighted challenge?
- Who are your proposed industrial partners for solving each challenge?

Idaho National Laboratory

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Additional Images