Resources: Natural, Energy, Water, for Society (ReNEWS)

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Focus on the exploration, extraction, and management of water, oil & gas, minerals, geothermal and other renewable energy, and space resources (minerals and volatiles) in asteroids, the Moon, and other space objects.
> History of research and education in these fields
> Relevant faculty expertise in several programs in both colleges
> Kummer Center for Resource Sustainability
> Leverage existing research centers (EMRGe, HPCC, CREE, and MRC)
Critical Minerals
Critical Minerals

> Minerals are important for national security, high tech applications and green energy
> There are major research challenges to ensure resilient supply of critical minerals
> These challenges require cross-disciplinary convergent research initiatives
Critical Minerals

- Broad expertise at S&T
  - O’Keefe Institute/CREE
  - Min, Met, Geo, and Env Eng; Eng Mgt; Geology; Econ; & Pol Sci
- Already seen some success in collaborative critical minerals research

Project Title: Unlocking Missouri’s Cobalt Potential

The Doe Run Resources Company, in collaboration with Missouri University of Science and Technology and OLI Systems, Inc., will develop a novel and economic process to remove materials from the mined ore and recover cobalt along with other valuable metals from Missouri resources. This new process could reduce U.S. dependence on foreign resources by 30%.
Critical Minerals

- Mineral exploration & management techniques benefit from and impact techniques in other areas of ReNEWS
- Significant research infrastructure on campus
- Partnerships with
  - USGS, NREL & NETL
  - Baker Institute, Rice University
Space Resources

Source: The Space Review
Space Resources

> Responsibly managing the natural resources of space
  - Volatiles (water, hydrogen, oxygen, carbon dioxide, ...)
  - Minerals (rare earths, platinum group metals, ...)
  - Novel environments (vacuum, microgravity ...)

> Requires new approaches to
  - Prospecting, extraction, processing, manufacturing
  - Policy, law, regulation

> Derived from S&T strengths in
  - Critical minerals
  - Subsurface energy
  - Water resources
> Earth demand for mineral resources is increasing
  – Population and quality-of-life expectations
> Space exploration is increasing
  – China, Europe, Japan, Russia
  – SpaceX, Boeing, Lockheed Martin
Space Resources

- Artemis to return to Moon by 2024 ($28B)
- Asteroid Apophis to near Earth in 2029
- Humans to land on Mars in 2030’s
- Local water, propellants, and fuels must be ready

ROI = region of interest
Subsurface Energy
Subsurface Energy

- Subsurface energy sources account for >80% of the US energy needs.
- Various storage and disposal activities rely on subsurface activities.
- DOE has established a focus area in Subsurface Science, Technology, Engineering, and R&D (SubTER).
- Stakeholders are more aware of the H&E impacts of subsurface activities.

https://www.energy.gov/subsurface-science-technology-engineering-and-rd-crosscut-subter
Subsurface Energy

Core research areas addressed by DOE SubTER and grand challenges
- Wellbore integrity and drilling technologies
- Subsurface stress and induced seismicity
- Permeability manipulation
- New subsurface signals
- Reactive fluid flow characterization
- Health and safety, and environmental impacts.

Expertise from many departments in Missouri S&T and other UM campuses
Subsurface Energy

> Various Funding Resources
  – Government Agencies: DOE SubTER, NETL, EPA, NSF, NIH
  – Gulf Research Program
  – Industry

> ReNEWS Impact
  – More competitive proposals with good teaming
  – Graduate Certificate in Subsurface Engineering
  – National reputation in specific areas
Water Resources
Water Resources

- Global societal importance
- Human health and drinking water
- Connections with food and energy
- Flooding and drought
Water Resources

> Interdisciplinary expertise at S&T
  - Engineering: Civil, Environmental, Geological, Chemical, Management and Systems; Science: Biology, Geosciences, Chemistry, and Political.

> Topics of expertise include (but are not limited to)
  - Groundwater and surface water hydrology, water-related infrastructure, water quality, flooding, remediation and water treatment.
Water Resources

> Water is a connector within RENEWS.
  – Direct links to mining, petroleum extraction, and space exploration.

> A variety of facilities already on campus for water research.

> Local partnerships with the USGS and MDNR.

> Direct connections to graduate education.
  – New Water Science and Engineering MS-degree.
  – Grad certificates in subsurface and surface water resources.
ReNEWS
Future plans?

Source: Roskill
Next Steps

> Looking to build on initial success to go after bigger proposals with large teams

> Opportunities:
  – Congressional plus-up process
  – Kummer Center for Resource Sustainability
  – New DOE Office of Critical Minerals Sustainability & SubTER
  – NASA & DARPA opportunities
  – DOE, EPA, USACE, FEMA, NOAA etc.
Questions?
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