

Position Title: Graduate/Post Graduate Researcher – Water Management Optimization and Environmental Impacts in Unconventional Natural Gas and Oil Systems

Department: Department of Energy

Agency: National Energy Technology Laboratory (NETL)

Level: Graduate, Post Graduate, or Faculty

Position Information: Temporary, 12 months Part time or Full-Time, (up to 40 hours per week)

Duty Locations: Pittsburgh, Pennsylvania

Who May Be Considered: United States Citizens & Foreign Nationals with appropriate approval

SUMMARY:

Through the Oak Ridge Institute for Science and Education (ORISE) this posting seeks motivated, post-graduate (PhD) or faculty researchers interested in working as part of a collaborative, interdisciplinary research team in the geologic and environmental sciences focus area at the Department of Energy's National Energy Technology Laboratory (NETL). NETL's Office of Research and Development (ORD) conducts research to advance the clean production and efficient utilization of domestic energy resources.

In line with that mission, NETL ORD is currently engaged in research to consider systems-level environmental performance of unconventional natural gas and oil extraction. As part of that effort, researchers are considering the use of optimization techniques to maximize the net environmental and economic benefits of shale hydrocarbon resource extraction. A candidate is sought to contribute to ongoing research to develop mixed-integer linear programming-based models to describe the optimized performance of water use/management associated with hydraulic fracturing of shale gas wells.

Hydraulic fracturing of multi-stage horizontal wells is now a commonly-applied industry practice to stimulate production and enable economic recovery of hydrocarbons from unconventional reservoirs (*i.e.*, shale gas and oil reservoirs). This practice uses millions of gallons of water per horizontal well – effectively consuming a large fraction of the applied water and significantly impacting the quality of the recovered volume. Industry practices seek to reduce the cost and environmental impact of water management by reducing withdrawal of fresh water, reducing fresh and byproduct water transportation, and reducing byproduct water disposal through water storage and treatment/reuse.

Decisions on how to manage water are typically made based on operator experience/intuition and ad-hoc consideration of scheduling/availability limitations. However, it is recognized that this water management system is quite complex, requiring accounting of a number of competing temporally- and spatially-dependent parameters and constraints, and that significant efficiencies in system-level performance may be realized by treating this problem using optimization formalism and related numerical algorithms (as compared with heuristic treatment). Furthermore, characterizing and accounting for environmental impacts (using midpoint indicators of those impacts, such as CO₂ emissions) of related activities will allow optimization that considers both environmental and economic performance.

The ideal applicant will have experience with formulation of optimization problems and development of mixed-integer linear programs to numerically describe those formulations, familiarity with unconventional fossil resource extraction and related water treatment/management systems, and familiarity with the quantitative assessment of

environmental impacts of industrial activity. Activities associated with this position will include:

- Developing quantitative expressions to characterize the environmental externalities (economic impacts of air emissions, CO₂ equivalent greenhouse gas emissions) of produced water management activities at the well cluster scale
- Integrating those characterizations into mixed-integer linear programming model to optimize hydraulic fracturing water use and optimize water use and management with respect to economic and environmental performance
- Exercising the optimization model to consider the performance of representative scenarios
- Contributing to the development of manuscripts and presentations to describe research methods, key findings and implications useful to inform policy-level decision making
- Presenting research findings to the scientific/engineering research community

For more information about research ongoing in NETL's Unconventional Resources Portfolio please visit: <https://edx.netl.doe.gov/ucr/>

KEY REQUIREMENTS:

- Applicants must be U.S. Citizens or approved Foreign Nationals
- Suitable for Federal employment, as determined by background investigation
- Must hold a Graduate or PhD degree from an accredited institution in a field appropriate for the applicant's area of expertise

HOW TO APPLY:

Applicants should apply through the Oak Ridge Institute for Science and Education (ORISE) program. The ORISE Program provides opportunities for undergraduate students, recent graduates, graduate students, postdoctoral researchers, and faculty researchers. NETL utilizes the ORISE program to support research and work within NETL's Office of Research & Development.

- Interested applicants should complete the online application at <http://www.ornl.gov/netl/>
- In the online application **list Robert Dilmore as your requested mentor**. This will associate your application with this job posting.
- If you have additional questions please contact Nancy Andres, Nancy.Andres@NETL.DOE.GOV, who is the NETL ORISE program contact.