Dr. Jeffrey M. Bielicki, Assistant Professor in Department of Civil, Environmental and Geodetic Engineering, with a joint appointment at the John Glenn College of Public Affairs, at the Ohio State University completed an Ohio Water Resources Center funded project via joined Office of Energy and Environment at OSU and USGS 104(b) subaward. This project titled "**Co-Optimizing Enhanced Water Recovery and CO_2 Sequestration"** seeks to improve our understanding of how carbon dioxide (CO_2) injection and brine extraction in CO_2-Enhanced Water Recovery (CO_2-EWR) can be co-optimized for the physical and economic tradeoffs between the amount of CO_2 that is injected and the amount of brine that is extracted. The long-term goal of this research is to identify viable locations for CO_2-EWR, the potential costs associated with a location, and optimal injection/production management strategies. The project could inform present and future water and energy planning, as well as public utilities commissions and regulatory agencies with oversight for subsurface injection and production of fluids by identifying the risks, costs, and benefits associated with the use of CO_2-EWR.

The relationships between water and energy are complex when considering CO_2 capture and storage (CCS) technology to reduce CO_2 emissions, which are a principle driver of human-induced climate change. The tradeoffs identified in this study include the amount of CO_2 injected into the storage formation and the amount of brine removed, reservoir pressure build up or relief due to injection and extraction, increased storage at the expense of brine treatment costs, and dependence on the value of water and CO_2 prices through a future CO_2 tax or cap-and-trade mechanism. The initial expectation of the study was that brine extraction increased the storage capacity of CO_2 within the reservoir. Yet when the relationship was investigated using the Finite Element Heat and Mass Transfer (FEHM) code (fehm.lanl.gov), a decreasing correlation between the total CO_2 injected and brine extracted resulted in higher CO_2 storage for scenarios with less extraction due to early breakthrough of CO_2 (Figure 1).

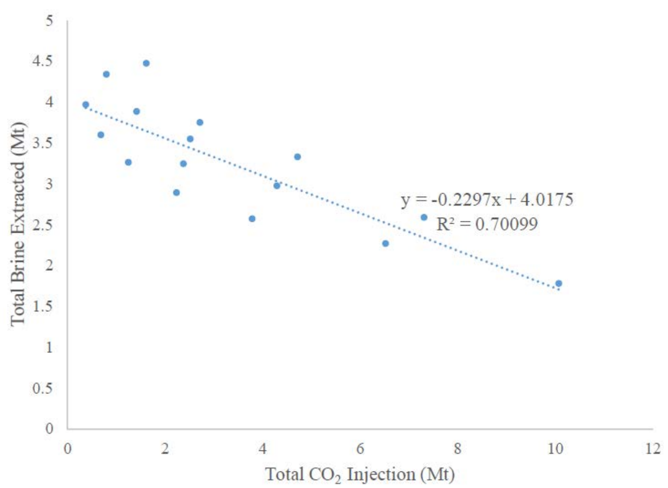

Figure 1 Relationship between CO_2 injection and brine extraction

Further research indicated that the high brine extraction rate pulled CO_2 through the reservoir at a faster rate because CO_2 could travel with less restriction in empty pore space. This suggested that the brine extraction rate had a greater impact on the lifetime of the CO_2-EWR system compared to the CO_2 injection rate and reservoir storage. When these results were combined with overpressure modelling of the reservoir, we concluded that the optimal brine extraction rate will be balanced between opening pore space and decreasing the time before CO_2 breakthrough at the extraction well. An equation, parameterized by the reservoir modeling, will be developed with the capabilities to estimate the viability of CO_2-EWR in various deep, saline aquifers and remove the current requirement to run a site specific subsurface flow model.

Researcher Profile: Dr. Jeffrey M. Bielicki holds a joint appointment in the Department of Civil, Environmental, and Geodetic Engineering and the John Glenn College of Public Affairs. He researches issues in which energy, environmental systems, and policy interact. He focuses on understanding opportunities, causes, and consequences of energy development and technology deployment in order to understand how energy systems have evolved and how this evolution can be directed in ways that will improve environmental, economic, and social conditions.