

SSAE Newsletter

APRIL // 2024

VOLUME 4.3



// ABOUT

The Strategic Systems Analysis and Engineering (SSAE) directorate provides the decision science and analysis capabilities necessary to evaluate complex energy systems. The directorate's capabilities address technical, economic, resource, policy, environmental and market aspects of the energy industry. These capabilities are critical to strategic planning, direction and goals for technology R&D programs and the generation of market, regulatory and technical intelligence for NETL senior management and DOE. SSAE offers a range of multi-criteria and multi-scale decision tools and approaches for this support:

- Process systems engineering research: advanced modeling, simulation and optimization tools for complex dynamic systems
- Process and cost engineering: plant-level synthesis, process modeling and simulation of energy systems with performance estimates
- Resource and subsurface analysis: evaluation of technologies, approaches and regulations for subsurface energy systems and storage
- Market and infrastructure analysis: economic impacts and program benefits
- Environmental life cycle analysis: cradle-to-grave emissions and impacts

These tools and approaches provide insights into new energy concepts and support the analysis of energy system interactions at the plant, regional, national and global scales.

// HIGHLIGHTS

Mathematical Optimization of Novel Water Treatment Technologies Demonstrated

SSAE researchers Adam Atia* and Tim Bartholomew coauthored the first publication to demonstrate the mathematical optimization of multiple key decision variables for a water treatment train while modeling detailed water chemistry phenomena like mineral scaling and precipitation. The authors achieved this by generating accurate surrogate models from OLI Systems water chemistry simulation software, and demonstrating that they are solvable at the process-scale with equation-oriented methods. The Water treatment Technoeconomic Assessment Platform ([WaterTAP](#)) and the Institute for Design of Advanced Energy Systems ([IDAES](#)) platform, which are open-source software tools developed by NETL, enabled this demonstration, see Figure 1. The work has been published in the journal ACS ES&T Engineering, "[Modeling Framework for Cost Optimization of Process-Scale Desalination Systems with Mineral Scaling and Precipitation](#)." [Learn more.](#)

DOE HQ's Jeffrey Hoffmann and Gregory Cooney (both formerly SSAE) were contributing authors for a section of [Chapter 7: Emerging Resources: Microalgae, Macroalgae, and Point-Source Carbon Dioxide Waste Stream](#) and were supported by SSAE researchers Timothy Fout (also formerly SSAE, now HQ), Gregory Hackett, Sally Homsey, Sydney Hughes*, Norma Kuehn*, Sarah Leptinsky*, Hari Mantripragada*, Tommy Schmitt*, Marc Turner* and Alex Zoelle*.

Section 7.3, "CO₂ Emissions from Stationary Sources," provides a high-level assessment of the potential for CO₂ captured from stationary sources to serve as a feedstock for biological-mediated processes that create carbon-based products. [Learn more.](#)

Local Treatment Needs and Critical Mineral Recovery Potential for Combustion Residual Leachate Published

Combustion residual leachate remains a significant wastewater management concern because of legacy ash ponds and landfills. Simultaneously, this leachate contains minerals that have value for the energy transition.

It is important to understand the treatment requirements and the potential for value creation from recovery of these energy-critical minerals while treatment systems are being designed for emergent regulations.

SSAE researchers Chad Able*, Alison Fritz, and Eric Grol characterized the potential to treat and valorize combustion residual leachate. They used composite information from National Pollutant Discharge Elimination System permits from different state-level databases to estimate treatment standards across the United States. Next, they conducted an analysis using Electric Power Research Institute leachate composition data and market information provided by the United States Geological Survey to determine

the mass and market size of each critical mineral available in combustion residual leachate, see Figure 2 and Figure 3. The findings can inform technology development and research on the cost and performance needs for recovery.

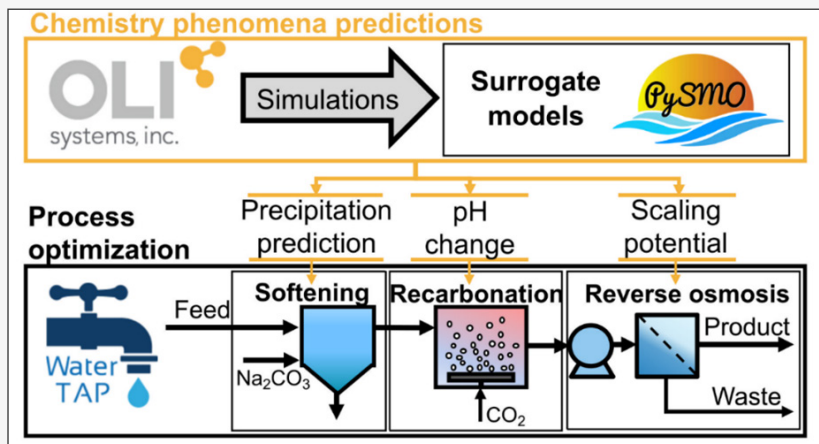
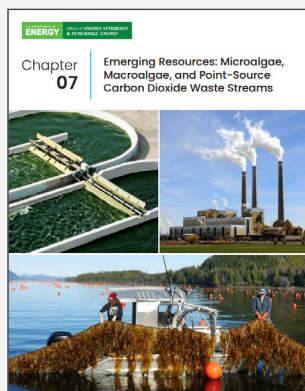


Figure 1 Schematic of water treatment train represented in WaterTAP and the detailed water predictions incorporated from OLI Systems.

SSAE Contributes to Department of Energy's 2023 Billion Ton Report



The U.S. Department of Energy (DOE) released [the 2023 Billion-Ton Report](#), which shows that the U.S. could sustainably triple its production of biomass to more than 1 billion tons per year. Advancing clean energy solutions utilizing biomass contribute to reaching long-term national decarbonization objectives.



// HIGHLIGHTS cont'd

The resulting manuscript "[Assessment of Combustion Residual Leachate: Local Treatment Needs and Critical Mineral Recovery](#)" has been published in Resources, Conservation and Recycling. The work was presented in November 2023 at the AIChE Annual Meeting in Orlando, FL.

the level of a "hydrogen economy." While the utilization of hydrogen has significant potential to reduce emissions in hard-to-abate sectors, more development of utilization pathways is required for larger scale deployment of hydrogen technologies. The results by Nadeja Victor* and Christopher

Nichols, "[Future of Hydrogen in the U.S. Energy Sector: MARKAL Modeling Results](#)", were published in the journal, Applications in Energy and Combustion Science, special issue entitled "Production, Storage and Utilization of Hydrogen."

Open Hydrogen Initiative (OHI) Releases OHI LCA Toolkit

SSAE, in collaboration with [GTI Energy](#) and [S&P Global Commodity Insights](#),



OPEN HYDROGEN INITIATIVE

developed the [Open Hydrogen Initiative \(OHI\) LCA Toolkit](#). The [OHI LCA Toolkit](#) is an open-sourced and standardized accounting methodology for calculating carbon intensity of hydrogen production, by analyzing various aspects such as material production, energy extraction, processing, transportation, and downstream carbon storage up to the hydrogen production facility.

The OHI LCA Toolkit calculates the global warming potential of assorted hydrogen production technologies. Users have the flexibility to either accept model defaults, adjust parameters, or input measured data. The initiative enables international agencies, market participants, and government bodies to understand the tradeoffs between cost and environmental impacts associated with hydrogen. The OHI LCA Toolkit was developed by a collaborative multidisciplinary team that includes SSAE researchers Megan S. Henriksen*, Jorge Izar-Tenorio*, Joseph T. Chou*, Priyadarshini*, Shirley Sam*, H. Scott Matthews*, and Matthew Jamieson.

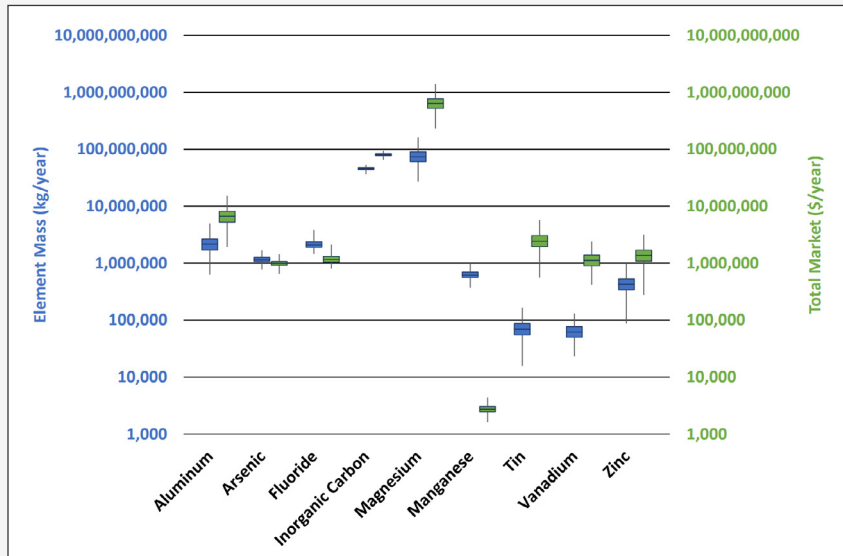


Figure 2 Critical Mineral Recovery from Impoundments

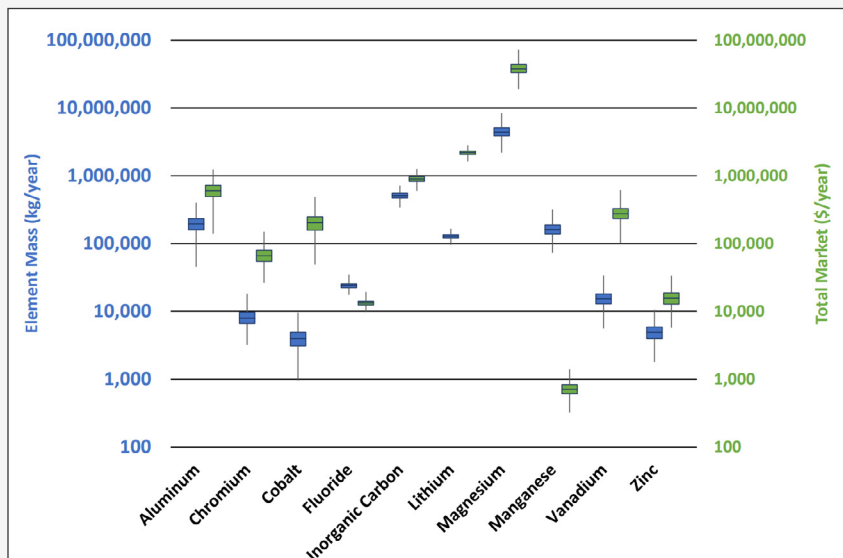


Figure 3 Critical Mineral Recovery from Landfills

Role of Hydrogen in Long-term Future Projections Explained

SSAE researchers, through modeling of a variety of future scenarios, provide context for the potential deployment of hydrogen production and utilization in the US. The analysis found that although tax incentives in the Inflation Reduction Act are likely to drive further production of hydrogen above the business-as-usual case, deployment levels do not reach

// HIGHLIGHTS cont'd



Staff Spotlight

Alex Zoelle has been key in contributing to a multitude of SSAE's techno-economic analyses related to CO₂ utilization, capture and removal, since joining the Process and Cost Engineering (PCE) team in 2012. He has authored [NETL Quality Guidelines for Energy System Studies](#), NETL's "[Cost and Performance Baseline for Fossil Energy Plants Volume 1: Bituminous Coal and Natural Gas to Electricity \(Revision 4\)](#)" and led analyses of direct air capture technologies resulting in the publication of NETL case studies on both [solvent-based direct air capture \(DAC\) systems](#) and [sorbent-based DAC systems](#).

Recent work has centered on industrial CO₂ capture including an analysis of CO₂ capture membranes for cement production with SSAE researchers Sydney Hughes*, Patricia Cvetic*, Richard Newby*, Sally Homsy, Mark Woods*, Eric Grol, and Timothy Fout. The study, "[The Impact of Cement Plant Air Ingress on Membrane-Based CO₂ Capture Retrofit Cost](#)," will be published in Carbon Capture Science & Technology, Volume 11, June 2024.

Alex grew up in the North Hills of Pittsburgh. He graduated from Wheeling Jesuit University in 2008 with a B.S. in chemistry and a minor in mathematics and completed his M.S. in chemical engineering from Villanova University in 2011. In his free time, he enjoys playing golf and ice hockey, but spends most of his time outside of work shuttling his four children to their various practices, games, tournaments, and competitions.

// NOTICES



Happy Trails to Steve Zitney

SSAE wishes Process Systems Engineering (PSE) researcher, Steve Zitney, the best of luck in his retirement after an illustrious career spanning 35 years. Steve was constantly at the cutting edge of the PSE field with major focuses on multi-scale simulation

and optimization as well as digital twin development, launching the AVESTAR Center for Advanced Virtual Energy Simulation Training and Research in 2011. More recently, Steve led several R&D efforts aimed at the design, operation, and control of flexible power systems while effectively championing the use of artificial intelligence/machine learning to continue to advance the state-of-the-art. Steve earned a B.S. from Carnegie Mellon University and an M.S. and Ph.D. in chemical engineering from the University of Illinois. His legacy of mentorship has positively impacted many careers during his 20 years at NETL and through service as an adjunct professor in the Department of Chemical and Biomedical Engineering at West Virginia University. Steve will be missed by colleagues who sincerely appreciated his leadership, technical prowess, and passion in all things PSE.



SSAE Bids Farewell to Eric Grol

SSAE bids farewell to Energy Process Analysis Team (EPAT) analyst, Eric Grol, as he transitions to NETL's Technology Development Center (TDC). Eric has been a significant contributor to SSAE since he joined its predecessor organization,

the Office of Systems Analysis and Planning (OSAP), in 2007. He led techno-economic analyses on a wide range of topics including fuel cells, energy-water nexus topics, and industrial carbon capture. Eric holds a B.S. and M.S. in chemical engineering from the University of Pittsburgh. He served as part of Fossil Energy's technical analysis team on air, water, and solid waste regulations. We truly appreciate his substantive efforts over the last 17 years and wish him well as he continues supporting DOE's point source capture efforts.



Welcome Chung Yan Shih to the Energy Systems Analysis Team

Chung Yan Shih is a strategic data scientist who has been supporting NETL in the applied energy domain as a site support contractor since 2010. He supported CO₂ saline cost modeling work, model development for life cycle analysis, uncertainty modeling, market analysis, geospatial supply chain modeling, and other SSAE missions. Recently, the

team he led in the Science-Informed Machine Learning to Accelerate Real-Time Decisions (SMART) successfully developed a CO₂ saturation prediction model reaching 5,000x faster than the traditional simulation time. Chung supported NETL's Key Lab Initiative, a Science-based artificial intelligence (AI)/machine learning (ML) Institute (SAMI) that catalyzes AI/ML capabilities across fields, such as material and manufacturing, subsurface, and computational science.

Chung earned a bachelor's degree in naval architecture and ocean engineering at the National Taiwan University, a master's in civil and environmental engineering at the National Chiao Tung University, a master's in computational science and engineering and a doctorate in advanced infrastructure systems at Carnegie Mellon University (CMU). When he is not at work, he enjoys playing LEGO, tasting all kinds of food, and traveling with his wife and two kids. He also enjoys serving as one of the advisors for CMU's Christian student club, helping international students settle down in Pittsburgh. To learn more, [see NETL's biography of Chung Yan Shih](#).

SSAE Discusses Repurposing of Assets at Bruce Mansfield Site

Analysis of the repurposing of fossil and coal assets has been a prime focus of work for SSAE researchers Ivonne Peña-Cabra*, Luke Clahane*, and Erik Shuster. Last month they were part of a contingent of staff from SSAE and DOE's Office of Policy that toured the [Shippingport Industrial Park](#), site of the shuttered Bruce Mansfield 2.4 GW Power Plant, see Figure 4. The group met with Frontier to discuss plans for repurposing the plant's assets to attract manufacturing jobs and support the local economy. The closed coal-fired plant was purchased by Frontier, a redevelopment company, in 2019. The site, located 35 miles northwest of Pittsburgh along the Ohio River, has 650 available acres (70 of which used to be a coal yard), a local substation of 345 kV and railway that runs into the site.

More information is available in the Pennsylvania Department of Community and Economic Development's "[Bruce Mansfield Power Plant Playbook](#)," an in-depth look at the site attributes

and the possible redevelopment strategies that have been researched for the site.



Figure 4. SSAE's Luke Clahane (third from left), Erik Shuster (fifth from left), Ivonne Peña-Cabra* (near center, seventh from left) and DOE Office of Policy Personnel with Shippingport Industrial Park Hosts

SSAE Shares Expertise at CCUS in Houston

SSAE researchers joined the DOE's Office of Fossil Energy and Carbon Management (FECM) Senior Program Manager for Carbon Infrastructure [Traci Rodosta](#)



and other NETL experts at the [Carbon Capture Utilization and Storage \(CCUS\) 2024](#), in Houston, TX, March 11-13, 2024.

The event was hosted by the Society of Petroleum Engineers (SPE), the American Association of Petroleum Geologists (AAPG), and the Society of Exploration Geophysicists (SEG). The conference brought together over 1,300 attendees and participants from all over the world. In addition to providing four poster presentations and participating in discussions focused on current CCUS work, SSAE representatives made four oral presentations.

Data Integration and Assessment

MacKenzie Mark-Moser presented "[Carbon Storage Technical Viability Approach and National Data Assessment](#)." NETL developed the Carbon Storage Technical Viability Assessment (CS TVA) approach that incorporates social and environmental factors that inform and accelerate screening for carbon storage (CS) site selection. The approach leverages spatial data science applications in a new workflow to analyze available data, identify gaps, and visualize uncertainty. Preliminary results from a national assessment of CS data availability were also presented. Inform and accelerate screening for carbon storage (CS) site selection. The approach leverages spatial data science applications in a new workflow to analyze available data, identify gaps, and visualize uncertainty. Preliminary results from a national assessment of CS data availability were also presented.

Economic and Modeling Studies for CCUS

In the presentation, "[Risk Considerations of Transitioning CO₂ - EOR Field to CO₂ - Storage Field: Case Study](#)," Guoxiang (Gavin) Liu discussed how transitioning operations from CO₂-EOR to storage can impact reservoir plume and pressure transient in the storage envelope, and how these changes could impact areas of review and potential unwanted fluid migration.

Maximizing Returns: Enhancing Profitability in CCUS Projects

Dave Morgan presented "[Modeling the Cost of Onshore CO₂ Pipeline Transport and Onshore CO₂ Saline Storage](#)" and described the FECM/NETL CO₂ Transport Cost Model (CO2_T_COM); a technoeconomic model of CO₂ transport by pipeline; the FECM/NETL CO₂ Saline Storage Cost Model (CO2_S_COM); and a technoeconomic model depicting storage of CO₂ in a deep, subsurface saline formation.

Financial, Economics, and Regulatory Framework

The poster "[Modeling Cost of Offshore Carbon Storage in Saline Reservoirs](#)" highlights NETL's carbon storage cost model for offshore saline reservoirs known as CO2_S_COM_Offshore. Based on NETL's widely used CO2_S_COM cost model for onshore saline, CS, CO2_S_COM_Offshore enables technoeconomic analysis of CS in offshore areas. The model comprehensively incorporates multiple facets of offshore CS projects, from regional evaluation and site selection to permitting, transport, operations, monitoring, site closure, and decommissioning. Developed by SSAE researchers Mackenzie Mark-Moser, Timothy Grant, David Morgan, Michael Marquis*, Kolawole Bello*, Alana Sheriff*, Derek Vikara*, Guoxiang Liu and Luciane Cunha to model cost for offshore United States (US) Exclusive Economic Zones, aspects of this model can be adapted to international projects.

ML and Data Analytics Applications

The poster, "[An Insight-Centric Paradigm for Data Reduction and Inference Speed Improvement at the Scurry Area Canyon Reef Operator's Committee \(SACROC\) Unit](#)," includes work by SSAE researchers Chung Yan Shih, Gavin Liu, Hema Siriwardane conducted under the SMART Initiative, that focuses on using an insight-centric approach to design a meaningful proxy for machine learning. Domain insights are critical not just in understanding the prediction results, but also in designing the model. This study demonstrated that a single meaningful scaler (as an extreme case) can effectively replace full-size 3D geologic properties. The model's accuracies are on par with other models, and it is the fastest model to predict all test cases, 5,000 times faster than traditional simulations.

The poster, (not yet published) "Using MeshGraphNets to Predict Geologic Behaviors of the Illinois Basin – Decatur Project (IBDP)," illustrates the use of a Graph Neural Networks (GNN) framework, to learn mesh-based simulations based

on the IBDP project. The research, by SSAE researchers C. Shih, P. S. Holcomb, G. Liu and H. Siriwardane, yielded several notable results and observations. GNNs demonstrate a remarkable ability to extract meaningful patterns and relationships from minimal datasets in carbon storage projects.

Case Studies

Offshore geologic carbon storage (GCS) is a relatively nascent industry, with disparate aggregations and summaries of offshore projects, opportunities, and lessons. The poster, "[International Offshore Geologic Carbon Storage Inventory and Meta-analysis](#)", illustrates SSAE researchers' Julia Mulhern*, MacKenzie Mark-Moser, Abigail Choisser*, Kelly Rose, compilation of an inventory of offshore GCS projects for graphical and spatial analysis. Numerical and categorical data for the inventory includes project type, size, location, estimated start date injection rate, commercial sector, CO₂ source sector, CO₂ transport method, reservoir lithology, reservoir fluid, water depth, distance from shore, reservoir depth porosity, permeability, and other factors. Preliminary analysis highlights that the most GCS projects underway are in Europe and that many efforts globally are being motivated by natural gas processing. While some less conventional play types are being explored, many offshore GCS projects target depleted oil and gas, sandstone reservoirs.

SSAE Brief from the 8th International Supercritical CO₂ Power Cycles Symposium

The [Supercritical CO₂ Power Cycles Symposium](#), held in San Antonio, Texas Feb 26-29, 2024, is a conference that highlights advances in the research, development, and application of supercritical CO₂ (sCO₂) cycles. The symposium consisted of several panel, plenary, and technical breakout sessions. One theme of the plenary and panel sessions was the need for sCO₂ systems to accelerate beyond modeling and testing to application. This is starting to happen (e.g., [MAN Energy Solution's heat pump application](#)). Although the conference topics related to solar, nuclear, and fossil energy cycle were prevalent, so were newer application areas related to pumped thermal energy storage (PTES) and heat pumps for process and district heating.

Two papers from works by SSAE researchers were presented. Jacob Albright presented, "[Multi-Model Predictive Control for Enhanced Load Following of a sCO₂ Recompression Brayton Cycle](#)." Authored by Albright and Eric Liese, the study focused on the application of model predictive control for enhanced load following using NETL's dynamic model of the 10 MWe STEP test facility at the Southwest Research institute (SwRI) in San Antonio. Albright contrasted the work with traditional controls for load following from previous work. The MPC approach provided both better and worse performance depending on the control measure and operational region. Suggestions were provided from the audience for future analyses. Albright also had discussions with GTI personnel about potential model comparison and validation activities.

// NOTICES cont'd

Cycle oscillations predicted by the NETL model are being seen in experimental startup data.

Eric Liese presented results showing a leveled cost of electricity optimization, using NETL's FOQUS software tool, of an sCO₂ bottoming cycle for an H-class gas turbine including 95% carbon capture in, "[Performance and Cost Potential of sCO₂ Bottoming Cycle for Gas Turbines with Carbon Capture – Paper 32](#)," authored by Liese and Sandeep Pidaparti*. This was compared with a traditional steam bottoming cycle. The comparison showed similar LCOE and efficiency. More details are available in the [conference paper](#). After the presentation, Liese had discussions with an attendee from GE Vernova who is analyzing a similar case study. Plans were made for future mutual exchange of approaches and ideas. Symposium proceedings are posted [here](#).

NETL Resource Sustainability Project Review

SSAE participated in the [2024 NETL Resource Sustainability Project Review Meeting](#) April 2-4, 2024, in Pittsburgh. Researchers presented updates on over 100 research projects funded by DOE FECM and NETL that address carbon ore processing; critical minerals and materials; environmentally prudent stewardship; water management technologies and gas hydrates; methane mitigation technologies; and natural gas decarbonization and hydrogen technologies. Conference proceedings are [here](#).



SSAE presentations and posters (one not yet published) include:

Alison Fritz, "[Critical Minerals: Systems Analysis Tasks \(FWP-1022420\)](#)."

Elmira Shamlou*, "[An Optimization Framework for Produced Water Management and Beneficial Reuse \(FWP-1022477\)](#)" and "PARETO – DOE's Produced Water Optimization Framework," an interactive demo.

C. Gabe Creason, "[Deploying a New AI Software Tool for Rapid Characterization & Quantification of Unconventional Sources of Critical Minerals \(TC-23NT020203\)](#)" and "Unconventional

Rare-Earth and Critical Mineral (URC) Assessment Method," an interactive demo.

Matthew Jamieson and Harshvardhan Khutal*, "[Life Cycle Analysis of Natural Gas Extraction and Power Generation: U.S. 2020 Emissions Profile \(FWP-1022424.6\)](#)."

Alana Sheriff*, "[Systems Analysis Perspectives of Methane Pyrolysis, Fossil-Based Ammonia Production, and H₂ and H₂/NG Transport \(FWP-1022467 \(5, 7, 8\)\)](#)."

Indra Bhattacharya and Mumbi Mundia-Howe*, "Natural Gas Infrastructure: Field-based Methane Emissions Quantification (FWP-1022424 Task 4)."

Thomas Tarka, "[PrOMMiS: Transforming Critical Minerals Process Development & Deployment through Modeling \(FWP-1025017\)](#)."

Fracturing Modeling and Simulation Workshop

SSAE Researcher, Guoxiang (Gavin) Liu, participated in a fracture modeling and simulation workshop in Oklahoma City Feb. 26 to 29, 2024. Discussions included modeling, simulation and optimization based on the field design and application for horizontal well fracture technologies. Those capabilities will help simulate decisions for further field operations. The purpose of the workshop was to gain knowledge and simulation capabilities to enhance NETL's fracture modeling and simulation. In particular, the knowledge and discussions were beneficial for the Laboratory Directed Research and Development (LDRD) CO₂ Enhanced Geothermal Energy Recovery project.

// UPCOMING CONFERENCES AND EVENTS

SSAE federal staff and NETL support contractor personnel have or will present or participate in the following events in April and May 2024:

- **FECM Point Source Carbon Capture Technology Team Meeting**
Washington, DC, April 3-4, 2024
Participants: Alicia Dalton-Tingler, Gregory Hackett, Sally Homsey, Benjamin Omell
- **[Subsurface Hydrogen Assessment, Storage, and Technology Acceleration \(SHASTA\) Technical Workshop](#)**
Pittsburgh, PA, April 3, 2024
Participants: Guoxian Liu, David Morgan
- **FECM Technology Assessment Modeler's Workshop**
Morgantown, WV, April 10-11, 2024
Facilitators: Justin Adder, Peter Balash, Greg Cooney (HQ), Tom Curry (HQ), Troy Hawkins, Jeff Hoffmann (HQ), Alicia Dalton-Tingler, John Wimer (HQ)
Presenters: Amanda Harker-Steele and Alex Zoelle*
- NETL Point Source Capture Analyses, Eric Grol and Gregory Hackett - NETL Carbon Capture Retrofit Databases (CCRD), Ben Omell and Mike Matuszewski*
- Carbon Capture Simulation of Industry Impact (CCSI2), Greg Cooney (HQ) and Jeff Hoffman (HQ) - Characterization of potential co benefits from capture – air quality modeling and removal of co-pollutants, and, CDR LCA Best Practices and Development of an Annual Technology Baseline, Dave Morgan and John Brewer - NETL CO₂ Transport and Storage Analyses, Michelle Krynock - 45Q Life Cycle Assessment, and, Carbon Dioxide Conversion Analyses, Tim Skone (HQ) - Characterizing Emissions from Natural Gas Supply Chains (MMRV Framework), Matt Jamieson - NETL Natural Gas Infrastructure Analyses, Eric Lewis - NETL NG Decarbonization and H₂ Technologies Analyses, and, NETL Gasification Analyses, Travis Shultz - NETL Baseline Studies, Tony Burgard, Tom Tarka, Tim Bartholomew* - NETL Simulation-Based Engineering – IDAES & supported projects, Ben Omell and Sally Homsey - Direct Air Capture Analysis.
- **Industrial Energy Base and Supply Chain Lab Consortia Planning Workshop**
Oak Ridge, TN, April 15 – 18, 2024
Participant: Thomas Tarka
- **[2024 FECM/NETL Spring R&D Project Review Meeting](#)**
Pittsburgh, PA, April 23 – 25, 2024
Presenters: Kyle Buchheit* and Alexander Noring* – Pathway Study for Large-Scale Hydrogen Production from Solid Oxide Electrolysis Cell Technology (FE0025912)
Anthony Burgard - IDEAS Integrated Platform for Multi-Scale Modeling & Optimization (FWP-1022423)
Gregory Hackett – Recent Progress in Solid Oxide Cell Technology Analysis at NETL (Task 4 - Strategic Systems Analysis and Engineering) (FWP-1022411), Eric Lewis
- Advanced Reaction Systems (FWP-1022405), Erik Shuster - Research and Development Opportunities for Thermal/Environmental Barrier Coatings and Ceramic Matrix Composites for Hydrogen Gas Turbines (FWP-1022406)
Participants: Peter Balash, Indrajit Bhattacharya, Eric Liese
- **[Offshore Technology Conference \(OTC\)](#)**
Houston, TX, May 6 – 9, 2024
Presenters: Timothy Grant - CCS Opportunity along the Gulf Coast Corridor, MacKenzie Mark-Moser - Data-driven, AI/ML tools for multi-factor offshore hazard assessment use case: Deepwater Gulf of Mexico
Participant: Luciane Cunha
- **[Annual Merit Review and Peer Evaluation Meeting U.S. Department of Energy Hydrogen Program](#)**
Arlington, VA, May 6-9, 2024
Presenter: Eric Lewis
Participants: Kyle Buchheit* and Alexander Noring*
- **[National Alliance for Water Innovation \(NAWI\) Workshop on Brackish Water Brine Concentrate Management](#)**
Phoenix, AZ, May 13 – 14, 2024
Participant: Alison Fritz
- **[RAPID Roadmap Workshop: Technology Valuation](#)**
Golden, CO, May 14 - 15, 2024
Panelist: Alison Fritz
- **[National Carbon Capture Center \(NCCC\) Project Review Meeting](#)**
Birmingham, AL, May 13 – 16, 2024
Participant: Sally Homsey
- **[Industrial Energy Base and Supply Chain Lab Consortia Planning Workshop](#)**
Oak Ridge, TN, April 15 – 18, 2024
Participant: Thomas Tarka
- **[Hitachi Energy Enterprise Software Solutions User Conference Americas 2024](#)**
Denver, CO, May 20-23, 2024
Participants: John Brewer, Kirk Labarbara, Erik Shuster
- **[2024 World Hydrogen North America Conference](#)**
Houston, TX, May 21 - 23, 2024
Participants: Luciane Cunha, Eric Lewis
- **[Global CO₂ Initiative 2024 Harmonizing Assessments of Carbon Management Approaches](#)**
Ann Arbor, MI (also online), May 21 – 23, 2024
Presenter: Michelle Krynock - Avoided Emissions
Participant: Gregory Hackett

// UPCOMING CONFERENCES AND EVENTS

(cont'd)

- [2024 Industrial Ecology Gordon Research Conference \(GRC\)](#)

Les Diablerets, Switzerland, May 26-31, 2024
Presenter: Alison Fritz

- **Mickey Leland Energy Fellowship (MLEF) Program Kick-off/Welcome**

Washington, DC, May 30, 2024
Participants: John Brewer, Amanda Harker-Steele

// RECENT PUBLICATIONS

Articles

- Hughes, R., Caballero, D.Y., Zamarripa-Perez, M., Omell, B., Matuszewski, M., & Bhattacharyya, D. (2024). [Modeling and Techno-Economic Optimization of a Tetraamine-Appended Metal–Organic Framework for NGCC-Based CO₂ Capture Using Fixed Bed Contactors](#). *Energy & Fuels*, 38(3), 2511–2524, January 2024.
- Zyrianova, M., Collett, T., Boswell, R., (2024). [Characterization of the Structural–Stratigraphic and Reservoir Controls on the Occurrence of Gas Hydrates in the Eileen Gas Hydrate Trend, Alaska North Slope](#). *Journal of Marine Science and Engineering* 12(3), 472. March 10, 2024.
- Gooty, Radhakrishna Tumbalam, Jaffer Ghouse, Quang Minh Le, Bhurisa Thitakamol, Sabereh Rezaei, Denis Obiang, Raghubir Gupta, James Zhou, Debansu Bhattacharyya, and David C. Miller. [Incorporation of Market Signals for the Optimal Design of Post Combustion Carbon Capture Systems](#)." *Applied Energy* 337, 120880, May 2023.
- Nadejda Victor, Christopher Nichols, (2024) [Future of hydrogen in the U.S. energy sector: MARKAL modeling results](#), Applications in Energy and Combustion Science, Volume 18, 100259, June 2024
- Hughes, S., Cvetic, P., Newby, R., Homsy, S., Zoelle, A., Woods, M., Grol, E., & Fout, T. (2024). [The Impact of Cement Plant Air Ingress on Membrane-Based CO₂ Capture Retrofit Cost](#). *Carbon Capture Science & Technology*, 11, 100201. June 2024

Presentations and Posters

- C.G. Creason, K. Rose, S. Montross, N. Maymi, A. Jackson, S. O'Barr, E. Bishop, P. Wingo, G. Hazle, S. Skipwith, A. Moyes, G. Lindemann, D. Atkins, J. Hird, F. Taglia, "[Deploying a New AI Software Tool for Rapid Characterization & Quantification of Unconventional Sources of Critical Minerals](#)," poster at 2024 NETL Resource Sustainability Project Review Meeting, Pittsburgh, PA April 2-4, 2024.
- A. Fritz, "[Critical Minerals: Systems Analysis Tasks](#)," presentation at 2024 NETL Resource Sustainability Project Review Meeting, Pittsburgh, PA April 2-4, 2024.
- M. Jamieson and H. Khutal, "[Life Cycle Analysis of Natural Gas Extraction and Power Generation: U.S. 2020 Emissions Profile Update](#)," poster at 2024 NETL Resource Sustainability Project Review Meeting, Pittsburgh, PA April 2-4, 2024.
- E. Shamlou, "[Project PARETO – DOE's Produced Water Optimization Initiative](#)," presentation at 2024 NETL Resource Sustainability Project Review Meeting, Pittsburgh, PA April 2-4, 2024.
- A. Sheriff, S. McNaul, D. Keairns, M. Woods, T. Warner, E. Lewis, R. Stevens, and D. Morgan, "[Systems Analysis Perspectives of Methane Pyrolysis, Fossil-Based Ammonia Production, and H₂ and H₂/NG Transport](#)," poster at 2024 NETL Resource Sustainability Project Review Meeting, Pittsburgh, PA April 2-4, 2024.
- T. Tarka, "[METALLIC: A Destination for CMM Innovation](#)," presentation at 2024 NETL Resource Sustainability Project Review Meeting, Pittsburgh, PA April 2-4, 2024.

// RECENT PUBLICATIONS cont'd

- Mark-Moser, M., Creason, C.G., Mulhern, J., Shay, J., Maymi, N., Lara, A., Rose, K. (2024, March 11). [Carbon Storage Technical Viability Approach and National Data Assessment](#) [Conference Presentation]. CCUS 2024, Houston, Texas
- Fout, T. (2021, March 3) [Cost and Performance for Coal and Natural Gas Plants with Carbon Capture](#) [Webinar Presentation]. Air and Waste Management Association CCUS Webinar, Virtual.
- Drouven, M., Zamarripa, M.A., & Tominac, P. (2024, February 6–8). [Creating Markets for Produced Water](#) [Conference Presentation]. Produced Water Society 2024 Conference, Houston, TX.
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