Tri-Laboratory Applied Energy Workshop: Modeling and Analysis of Current and Future Energy Systems

Dates: April 25–26, 2019
Venue: National Energy Technology Laboratory, Pittsburgh, PA
Gate Address: 1538 Wallace Rd, South Park Township, PA 15129
GPS Coordinates: 40.300521,-79.977682

Organizers

- Idaho National Laboratory (INL)
- National Energy Technology Laboratory (NETL)
- National Renewable Energy Laboratory (NREL)

Description

The tri-laboratory modeling and analysis workshop will address the question of how modeling can help identify opportunities to enhance the performance and potential of current and future energy systems, with a specific focus on coordinated or tightly coupled integrated energy systems (often referred to as "hybrid" systems). Over the course of this 1.5-day workshop, best practices and approaches for energy system modeling and planning will be identified through moderated discussion among model developers and analysts. Participating researchers will be selected from each of the applied energy laboratories (namely, INL, NREL, and NETL) and will also include developers of key modeling and analysis tools at collaborating laboratories, academic institutions, and industry. Participation will be limited to ~60 invited attendees to ensure discussions remain focused and to enable small-group brainstorming and strategic planning of activities.

Participants (By Invitation Only)

- Relevant programmatic leadership within INL, NREL, NETL
- Key contributors to energy systems modeling and analysis
- Model developers, collaborators within other DOE laboratories, academia, industry.

Workshop Goals

- Identify relevant modeling and analysis tools for energy system design, optimization, planning, etc.
- Clarify key applicability of each model or tool, as well as shortcomings
- Criteria for different use cases
- Highlight gaps among the suite of existing tools that, if filled, would allow better support to energy planning
- Develop a strategic plan for modeling and analysis of current and future energy systems
- Identify the unique role and contribution of different modeling scales (from market to grid to process system to energy device) to address the challenges associated with developing technologies to enable the integrated energy systems of the future
- Enable holistic modeling and analysis that can identify the unique needs and contributions of each energy source that may be part of a coordinated or integrated energy system.

Basis of Discussion

The workshop will use three case studies to focus discussions on the types of challenges that must be addressed in planning future energy systems. These case studies have been carefully selected to ensure that they provide opportunity for multiple energy generation sources—namely nuclear, renewable, and fossil—and both electric and non-electric output commodities. Detailed descriptions of these regional cases will be provided prior to the workshop to prepare participants for focused dicussions.

Workshop Agenda (Thursday, April 25)

Time	Topic	Speaker/Moderator
08:00	**Arrive, Badging**	
08:30	**Welcome & Safety Briefing** **Overview of Tri-Lab Consortium Framework and Goals**	Dr. Brian Anderson, Director, NETL
08:50	**Overview of Workshop Goals and Desired Outcomes** Key questions to be addressed for broad energy systems analysis and planning: • How does modeling help to identify opportunities, particularly for tightly coupled integrated/hybrid energy systems and coordinated energy systems? • How are opportunities currently evaluated? • How can we approach energy system design and optimization (e.g., configuration, sizing, dispatch)? • What aspects of system control need to be addressed? • How can modeling help reduce technical risk during all stages of technology development? • How can multiple energy sources be integrated at multiple scales, including development of new technology/approaches? • What framework is necessary to assess performance at the grid, process, dynamics, and device levels? Some examples of ongoing/current work will be provided to frame the problem.	Shannon Bragg-Sitton, INL
09:10	**Overview of Modeling and Simulation Capability Needs** • Necessary model scales (process system, grid/market) ○ Inputs/data exchange among/between scales • Desired metrics for energy system evaluation • Energy system evaluation: Technical performance • Energy system evaluation: Economic performance • Treatment of energy markets Define key functional areas for energy systems (e.g., key metrics and performance characteristics) that should be assessed via modeling and analysis	Peter Balash, NETL Mark Ruth, NREL
09:30	**BLCOE Overview**	Mark O'Malley, NREL
09:45	**Overview of Toolsets: Brief Introduction to Tool Survey Results** Survey of applicable tools across the DOE lab complex, academia, and industry	David C. Miller, NETL
10:15	**Break**	
10:30	**3 Breakout Group Discussions** • **Process Systems (David C. Miller, NETL)** • **Grid/Market (Wesley Cole, NREL)** • **Future Scenarios (Cristian Rabiti, INL)** *Detailed discussion topics and outcomes for each breakout will be provided separately prior to the workshop* **Desired Outcome**: Identify best practices and define a strategy to work toward a common approach and/or integrated development of modeling and optimization tools Detailed discussion of tool capabilities in breakout groups: • Focus, key outputs • Modeling assumptions • Scale bridging assumptions • Model fidelity • Pros and cons (speakers should be encouraged to be very honest about the cons) • Complexity level (how much training is needed?) • Model V&V (what has been done?)	

	Discussion: • Identify gaps • Set “standardization” approaches • Highlight necessary linkages between tools	
12:00	**Working Lunch:** Participants to pick up lunch and return to breakout group discussions	
1:30	**Report Out from Breakouts**	
2:30	**Scale-Bridging Process to Grid/Market (large group mediated discussion)** Approach for tool integration into a broader modeling framework (i.e., an inter-sector energy model that can be used for energy system planning, performance analysis, etc., at multiple levels of fidelity) • Establishing a standard collaboration platform • Time/length scales	Richard Boardman, INL
4:00	**Approaches for Integration of Modeling and Experiments (large group mediated discussion)** • Using models to help design experiments to reduce technical risk and accelerate development/deployment • Design of Experiments, V&V	Michael Matuszewski, NETL
5:30	**Conclude**	

Workshop Agenda (Friday, April 26)

Time	Topic	Speaker/Moderator
08:00	**Introduction to Case Studies** • Set the stage for the case study discussion • Energy market, market transitions • Available generators (nuclear, renewable, fossil, water needs, etc.) • Other variables to consider? How would this case study best utilize the available tools to achieve the desired answers?	Jill Engel-Cox, NREL Shannon Bragg-Sitton, INL David C. Miller, NETL
08:45	**Breakout Groups on Case Studies**	
10:30	**Report Out from Breakout Discussions**	
11:30	**Path Forward Discussion: Strategy Development and Roadmapping**	Doug Arent, NREL
12:15	**Final Comments**	Brian Anderson Director NETL
12:30	**Adjourn**	
Optional Tour		
12:45	**Drive to R&D Site**	
1:00	**Tour Begins**	
	Materials Processing & Power Electronics - Embedded sensors for monitoring of CO_2 migration and groundwater impacts for CO_2 sequestration, corrosion monitoring in wellbores and natural gas pipelines, and in-situ process control in high-temperature power generation systems such as SOFCs, gas turbines, and combustion systems. The laboratory capabilities are also relevant for many other high priority emerging needs for advanced sensors within DOE including the Grid Modernization Laboratory Consortium as well as process monitoring and control for advanced manufacturing processes.	Paul Ohodnicki, NETL
	Coal-Based Carbon Materials - Lightweight carbon fiber composites, carbon additives for construction materials, battery and electrode materials, and carbon nanomaterials. NETL efforts focus on processing domestic coal to make carbon nanomaterials that improve the strength, durability, and optical properties of composites.	Christopher Matranga, NETL
	Shales as Seals & Unconventional Reservoirs - Fractured, organic-rich shales have been shown to be both a source rock and a trap in unconventional gas and oil. NETL is investigating fundamental geochemical interactions between CO_2, fluids, and shale to understand the storage permeance of CO_2 and the effectiveness of CO_2 to behave as a fracturing agent or to mobilize hydrocarbons.	Angela Goodman, NETL
	Rare Earth Element Enriched Byproducts - DOE and NETL are pursuing innovation related to the commercialization of REEs extracted from coal-related products. NETL utilizes advanced solid characterization (e.g., sequential extraction and synchrotron technologies) to tailor extraction processes for several types of coal byproducts.	Christina Lopano, NETL
2:00	**Conclude Tour**	