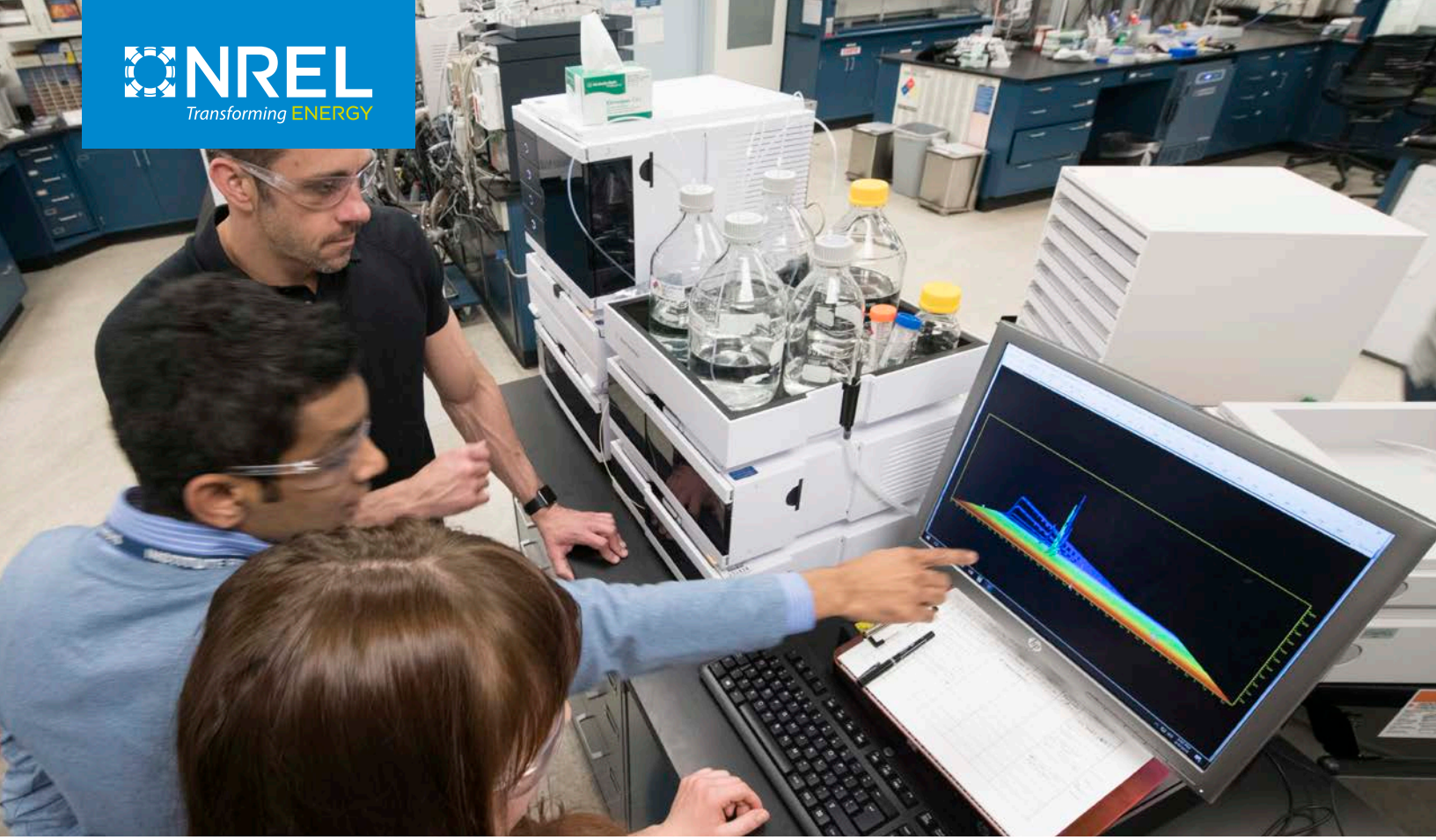


NREL researchers Christopher Johnson, Lahiru Jayakody, and Rita Clare use high-performance liquid chromatography to research a strain of engineered plastic-eating microbes in the character analysis lab at the Field Test Laboratory Building at NREL *Photo by Dennis Schroeder, NREL 56214*

Circular Economy Modeling and Analysis

NREL is working to transform the "linear economy"—where materials are simply used and disposed—into a circular one. The linear economy is not only unsustainable and inefficient, but will ultimately bring us face-to-face with resource limitations. NREL is dedicated to developing a circular economy for energy materials, with reliability, repair, reuse, remanufacture, and recycling in mind.

Modeling and analysis underpin all of NREL's work in the circular economy for energy materials. Using innovative models and research capabilities, NREL provides credible, objective analyses of clean energy systems throughout their life cycles.

Core Competencies and Capabilities

- **Identifying New Circular Economy Pathways**—To identify the most promising circular economy strategies for a decarbonized, sustainable future, NREL analysts develop models that simulate the impacts of clean energy products and circular pathways. The models use dynamic, systems-based approaches to accurately capture the complexity of circular transitions.

Why Partner with NREL?

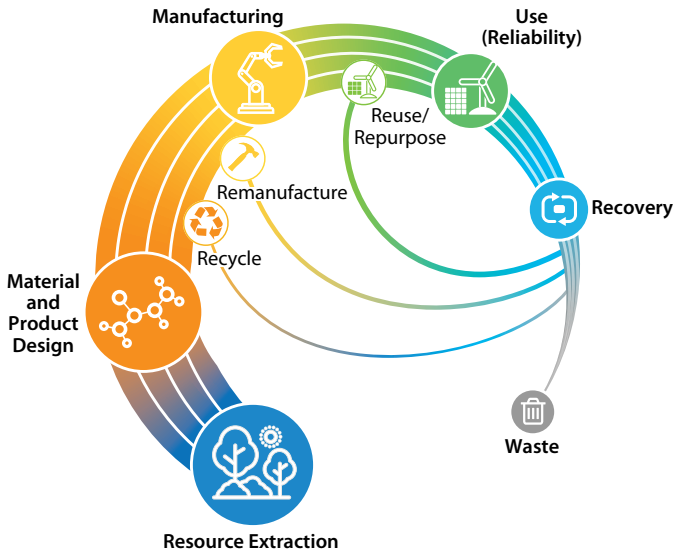
- NREL has the capability to perform life cycle environmental, technical, economic, social, behavioral, and regulatory analysis and modeling of clean energy technologies and supply chains.
- NREL's modeling and analysis can provide key insights into the complex tradeoffs inherent in clean energy systems, areas for improved efficiency, and new circular economy pathways.
- NREL is committed to ensuring our research gets to market—where it can improve everyday life and strengthen our economy. We have nearly 900 active agreements with almost 600 partners, over half of which are private-sector companies.

- **Assessing Complex Tradeoffs**—To enhance both ecological and human benefit in circular transitions, NREL researchers perform life cycle environmental, technical, economic, social/behavioral, and regulatory analysis of clean energy technologies and supply chains. Researchers use this information to assess tradeoffs, with the aim of identifying promising opportunities for circular transitions. Tools such as agent-based modeling and life cycle assessment provide insight into the full complexity of these tradeoffs.
- **Enabling New Efficiencies**—Using state-of-the-art modeling and analysis tools, NREL researchers develop insights that can drive future research and development, inform policy and investment decisions, and guide better technology design. These insights enable new efficiencies by helping extend product lifetimes; repair, reuse, or recover valuable materials; and improve energy systems overall.

Suite of Modeling and Analysis Tools

NREL has developed a comprehensive suite of tools for modeling and analysis of clean energy system life cycles, including:

- **Bio-Based Circular Carbon Economy Environmentally Extended Input-Output Model (BEIOM)**—The *BEIOM model* quantifies economy-wide environmental and socioeconomic impacts of new biofuels, bioproducts, or portfolios of biofuels and bioproducts.
- **Circular Economy Agent-Based Model**—The circular economy agent-based model demonstrates how interactions between a system's actors might help maximize circularity.
- **Circular Economy Lifecycle Assessment and Visualization Framework (CELAVI)**—The *CELAVI framework* quantifies the environmental, social, and economic impacts of circular economy transitions.
- **Lithium-Ion Battery Resources Analysis (LIBRA)**—The LIBRA analysis evaluates global trends in supply and demand for critical materials in lithium-ion batteries.
- **Materials Flow Through Industry Tool (MFI)**—The *MFI tool* identifies and assesses carbon emissions and energy and material demands from the supply chain.
- **Photovoltaics in the Circular Economy (PVICE)**—The *PVICE analysis* quantifies the material and energy impacts of photovoltaic system designs, lifetime, reliability, and disposal.



NREL's circular economy for energy materials promotes sustainability of essential supply chain materials. *Image by Elizabeth Stone*

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