



# Transforming **ENERGY** Through Computational Excellence

## Advanced Scientific Visualization Reveals Energy Insights

The National Renewable Energy Laboratory's (NREL's) world-class researchers and analysts and the Insight Center—a state-of-the-art scientific visualization facility—make data immersion a virtual reality by enabling users to step into and explore their data.

Scientific visualization translates large volumes of data into accessible imagery, providing visual context that helps researchers analyze and extract insights from large, diverse, and distributed data sets. Interaction with these multidimensional images enables detection and identification of data patterns, reveals correlations between different measures, shows the effects of real-time changes to parameters, and helps build new understandings of complicated dynamics.

### Inform and Accelerate Decisions

NREL's world-class visualization experts bring data to life, applying best practices for data management, resolution, and formatting to ensure successful, immersive discovery and informed decision-making.

We immerse community decision makers, scientists, and analysts in accessible visualizations, providing unparalleled decision support, helping them discover pathways to decarbonization goals. Likewise, our facilities and

understanding of human cognition enables partnerships between scientists and corporations taking a fresh approach to creating new clean energy materials.

We push the state of the art in visualization science so you can:

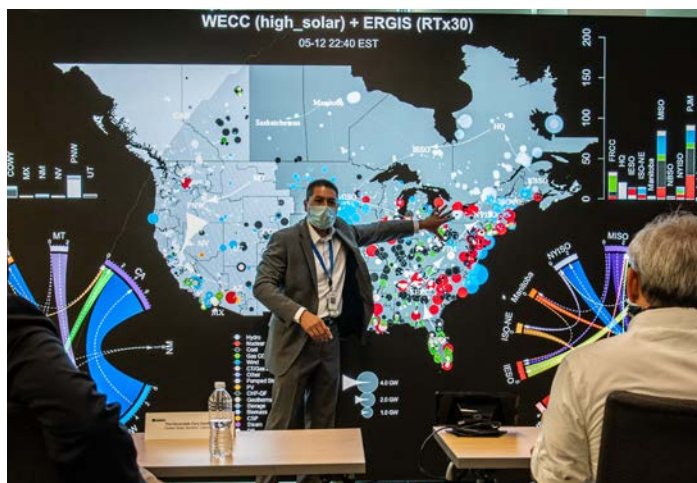
- **Understand:** How long have you been staring at your data? Visualization makes data more natural for the human mind to comprehend, so you can quickly gain a clearer understanding of large volumes of data and information.
- **Explore:** Today's data sets do not fit in a spreadsheet; they cannot be viewed in a table. Visualization can illuminate relevant patterns and relationships, highlight important features and trends, or even provide a whole new understanding of your data.
- **Validate:** Errors can hide in data acquisition, creation, and transformation, and simple modeling errors can ruin entire simulation runs. Different views of the data can help detect issues—it's a fairly simple way to help ensure your data is right.
- **Share:** Handing off rows and columns is inefficient! Visualization can make large data sets accessible to more collaborators and partners.
- **Communicate:** Visualization reduces the noisiness of raw data and highlights the useful information to tell a story. Stories engage others in your results.

# NREL's Insight Center Enables Collaboration

Located within the Energy Systems Integration Facility (ESIF), NREL's Insight Center offers visualization facilities that allow researchers and partners alike to walk into and through simulations and examine energy systems from new angles.

Interactive visualization of highly complex, large-scale data, systems, and operations in **three dimensions** and in **real time** occurs in the **Collaboration Room**. This immersive "cave" includes rear- and ceiling-mounted projectors, bringing scientific data to the human scale. Head-mounted displays can provide individualized virtual reality or augment reality to bring data to life. These advanced visualization technologies bring together researchers, analysts, and decision makers from all disciplines of science and engineering and enable new perspectives and insights that would not be possible in other environments.

Large-scale, **high-resolution, two-dimensional** imagery is displayed on a 100-megapixel display and a **touch-enabled wall** in the **Visualization Room**. Imagery effectively conveys information and illustrates research findings so researchers and partners can gather to interactively explore simulations, ensembles of simulations, and highly detailed visual analytics.



In the Visualization Room, NREL Associate Laboratory Director Juan Torres discusses the Interconnections Seam Study, which explored how a more integrated power system could drive resiliency and economic growth, informing grid planners, utilities, industry, policymakers, and other stakeholders. *Visualization by Kenny Gruchalla; photo by Dennis Schroeder, NREL 62392*

## Capabilities

- **Data science and advanced analytics:** We transform, translate, and process large-scale data sets into analysis-ready formats. Advanced analytics approaches ensure that visualizations answer the right questions.
- **Human-computer interaction:** We enable social computing, learning and education, and emergency planning and response through multimodal, context-aware interaction techniques.
- **Immersive and interactive visuals:** We implement new interaction and display technologies to support analytical reasoning and decision-making.
- **Uncertainty visualization:** We research and design novel methods for conveying variability, identifying erroneous or missing data, and validating data.
- **Custom software:** We develop software for all stages, including data processing, novel dashboards, and pathways to immersive displays. We support software such as ParaView and VisIt to empower interactive, in situ visualization on NREL's supercomputer.

## Partner With Us

NREL's expertise in advanced scientific visualization enables analyses of large, diverse, and distributed data sets to reveal insights and new understandings of complicated dynamics and inform technical, economic, and policy decisions. We work with leadership from Patagonia, Kraft Heinz, World Wildlife Fund, Los Angeles Department of Water and Power, Dallas Fort Worth International Airport, Southern California Gas Co., and more.

Read more about scientific visualization at <https://www.nrel.gov/computational-science/visualization-analysis-data.html> or contact us at:

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*Cover image:* Senior Scientist Kenny Gruchalla interacts within a three-dimensional computational fluid dynamics simulation that utilizes particle tracing to depict airflow and temperature from electric vehicle cabin zonal cooling, as part of a cooperative research study with Ford. *Visualization by Nicholas Brunhart-Lupo; photo by John De La Rosa, NREL 67185*



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