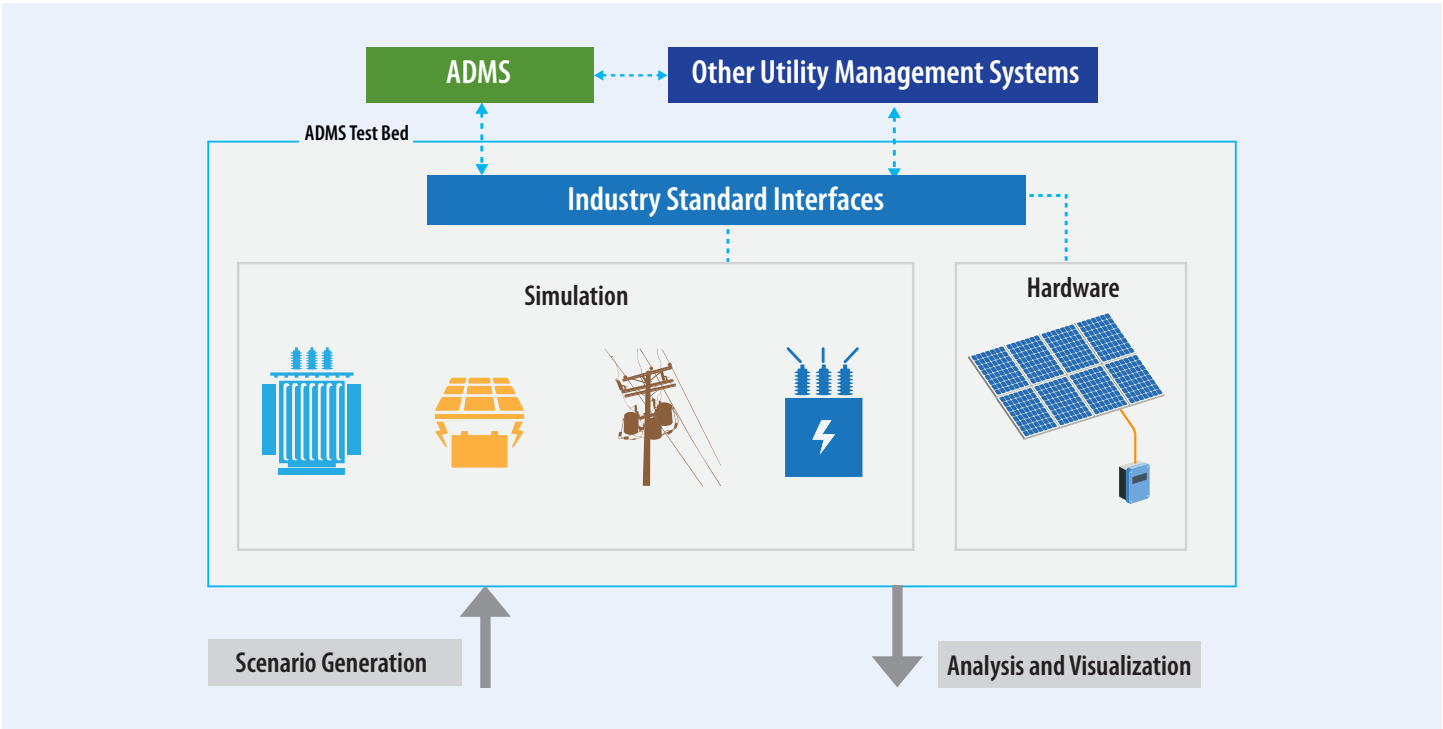
UTILITIES FIND SUCCESS USING NREL'S **ADMS TEST BED** FOR GRID MODERNIZATION

The National Renewable Energy Laboratory (NREL) and the U.S. Department of Energy's (DOE's) Office of Electricity have developed a vendor-neutral, advanced distribution management system (ADMS) test bed to accelerate grid modernization efforts for utilities using an ADMS. NREL has partnered with utilities to demonstrate three grid modernization use cases.

Background on NREL's ADMS Evaluation Platform

The ADMS test bed is an evaluation platform for utilities and vendors to safely learn how their systems and controls will perform in a realistic environment prior to deployment. The ADMS test bed can simulate just about any modern grid scenario—and achieve realistic results to validate a utility's modernized system before it is deployed.

The ADMS test bed consists of software simulation and hardware elements that recreate a power distribution system in the laboratory, which a commercial or precommercial ADMS can interface with using industry-standard communications protocols. Other utility management systems—such as a transmission-level energy management system (EMS), distributed energy resource management system (DERMS), or microgrid controller—can also be integrated with the ADMS test bed.



NREL has partnered with utilities to demonstrate three grid modernization use cases using its ADMS test bed. For each of the use cases, a set of scenarios was generated and then simulated. System behavior was observed using real-time visualization tools, and the data were stored to enable analysis.
Illustration by Anthony Castellano, NREL

Three Studies: Lessons Across the Industry

Since the ADMS test bed was created, NREL has been soliciting industry advice for the most important use cases. The following use cases reflect the interests of utility partners and can be broadly applied across the sector.

Xcel Energy Studies Impact of ADMS Network Model Quality

Like many utilities, Xcel Energy is looking to reduce energy use and monthly bills for its customers, specifically with an ADMS application for more precise voltage control. In doing so, the utility faces a tradeoff that depends on its confidence in the ADMS network model. If Xcel Energy is less confident in the ADMS model, it can keep voltage levels higher to avoid undervoltage events. Alternatively, the utility can invest in data cleansing to gain more confidence and increase energy savings with less conservative voltage settings.

Because data cleansing is expensive and time-consuming, NREL's ADMS test bed was used to help Xcel Energy and their ADMS vendor, Schneider Electric, learn the necessary amount of cleansing to make the most of its ADMS investment. Results made the comparison clear—a low-quality ADMS model resulted in numerous voltage exceedances and multiple utility equipment operations, while the highest quality model resulted in significant reductions in both and showed an increase in energy savings.

Holy Cross Energy Proves Distributed Grid Control with Renewable Energy Resources

Residents of a rural Colorado community are quickly adopting new energy technologies at the grid edge, challenging utility cooperative Holy Cross Energy to modernize its system and continue to offer resilient and affordable power. Holy Cross sought to test NREL's real-time control algorithms, developed under a project funded by DOE's Advanced Research Projects Agency-Energy (ARPA-E), which manage distributed energy resources (DERs) to regulate distribution voltages, reduce peak demand, and provide more cost-efficient energy use for DER owners.

Using the ADMS test bed, Holy Cross could see with high fidelity how the control techniques would impact their customers by managing a variety of assets at the grid edge interfaced with the utility's ADMS, provided by Survalent. Following the ADMS testing, Holy Cross successfully deployed the control techniques in a net-zero emissions, affordable housing community. The NREL algorithms were programmed onto controllers located within the homes.

Data-Enhanced Hierarchical Control Optimizes System Performance

A third use case, Enhanced Control and Optimization of Integrated Distributed Energy Applications (ECO-IDEA), used the ADMS test bed to validate a new control architecture. The project, funded by the DOE Solar Energy Technologies Office through the Enabling Extreme Real-Time Grid Integration of Solar Energy (ENERGISE) program, aims to help utilities optimize systems with high penetrations of distributed generation, using both legacy assets and new grid-edge devices.

Partnering with Xcel Energy, Schneider Electric, the Electric Power Research Institute, and Varentec, NREL demonstrated this architecture that seamlessly integrates multiple voltage-regulation technologies. On a simulated Xcel Energy feeder, the architecture achieved reliable and efficient system-wide operations at multiple spatio-temporal scales in the face of volatile ambient conditions. Results showed that by coordinating the control of legacy assets and new devices, such as photovoltaic (PV) systems and grid-edge dynamic reactive power devices, utilities can achieve significant improvements to voltage conditions under high penetrations of distributed PV.

NREL's ADMS test bed provides a realistic representation of a power distribution system that can be integrated with a commercial or precommercial ADMS to evaluate performance under many different conditions and grid modernization scenarios at no risk to customers.

To learn more about the ADMS test bed, visit nrel.gov/grid/advanced-distribution-management.html

Each ADMS project has unique objectives and challenges. We want to hear about yours.
Contact Murali Baggu, Laboratory Program Manager for Grid Integration and ADMS Program Lead, at Murali.Baggu@nrel.gov for more information.

NREL

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