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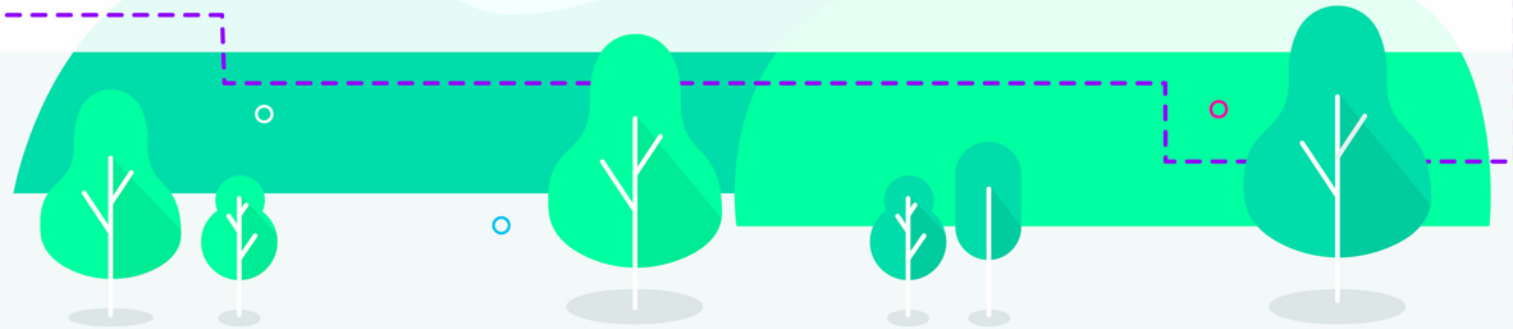

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Orange County Convention Center
Orlando, Florida, USA

A Case Study in NREL DERMS Asset Management Implementation

Sarah Williams, Research Project Manager | Energy Systems Integration Facility- National Renewable Energy Laboratory

Kevin Morrissey, R&D Manager- Smarter Grid Solutions

February 27, 2024- 3:30 PM

NREL/PR-5B00-88944

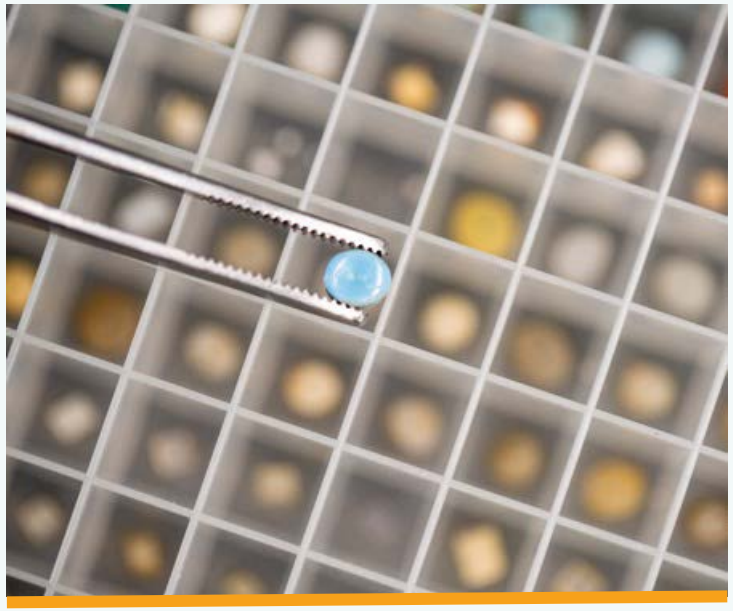
Agenda

- Sarah Williams (NREL)
  - NREL Introduction and ESIF Capabilities
  - DERMS Testbed Project Background
- Kevin Morrissey (SGS)
  - Strata Grid DERMS Capability
  - Future of Project
  - Future Opportunities for NREL Testbed

Integrated Energy Pathways

Electrons to Molecules

Circular Economy for Energy Materials

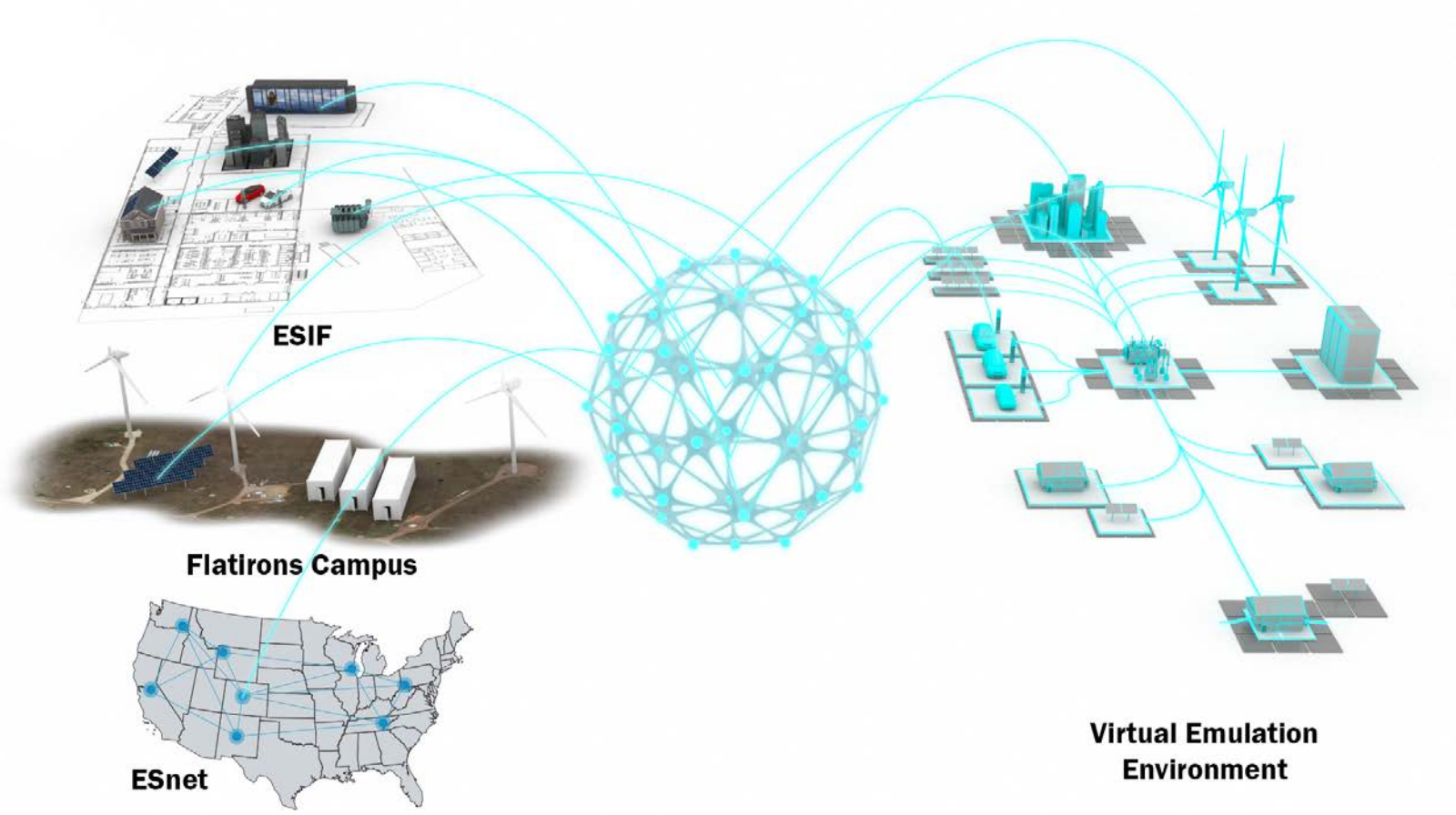


NREL's Vision:

A Clean Energy Future for the World

Three critical research areas respond to today's energy challenges and provide tomorrow's solutions

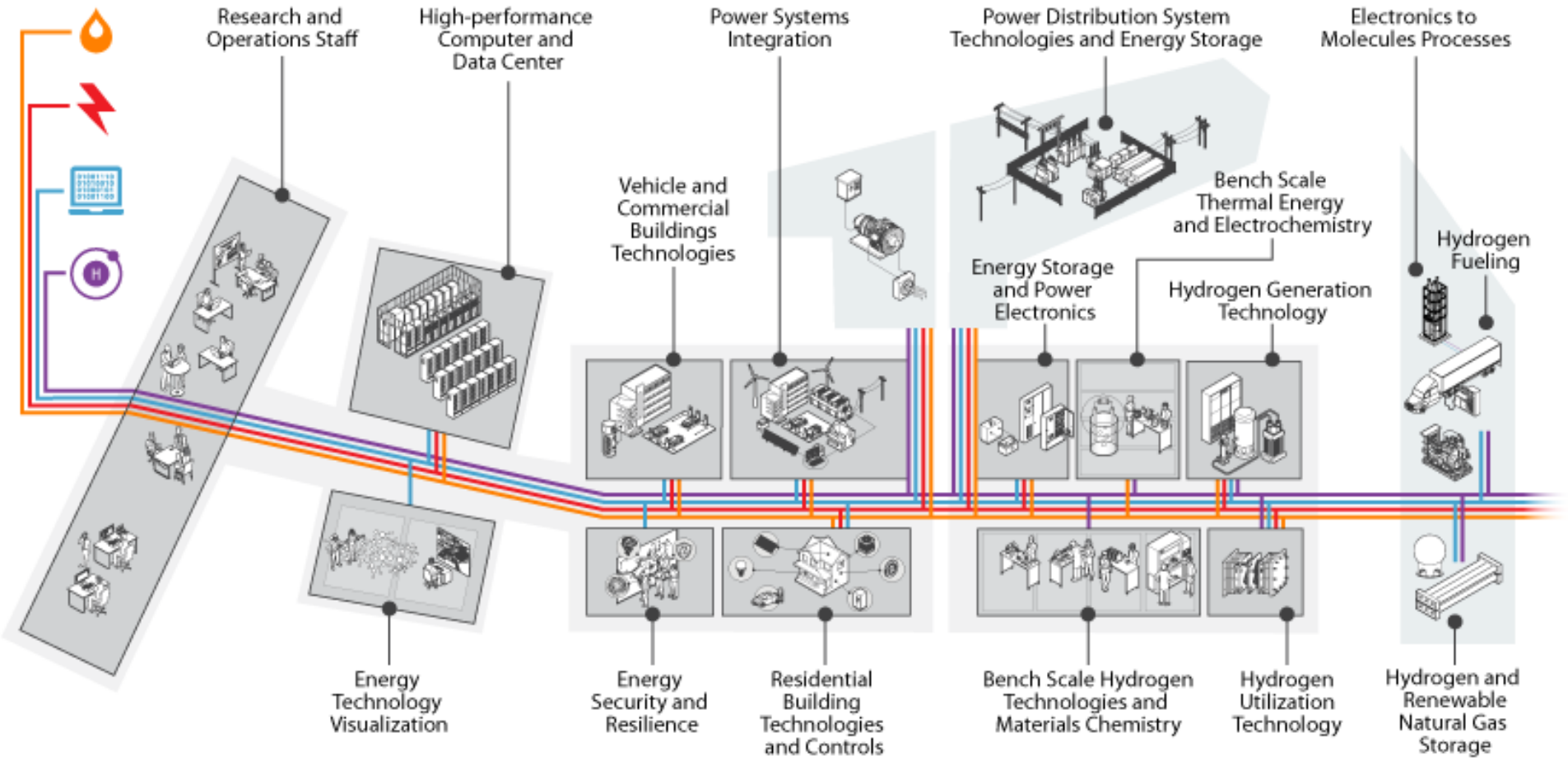
Advanced Research on Integrated Energy Systems (ARIES)



ARIES is DOE's research platform to validate our future integrated energy system with increasing renewables, storage and loads at a size and scale that matters.

Graphic by NREL

Energy Systems Integration Facility (ESIF)



Research Electrical Distribution Bus

Energy Data, Cyber and Control Networks

Thermal Integration Infrastructure

Hydrogen Systems

Graphic by NREL

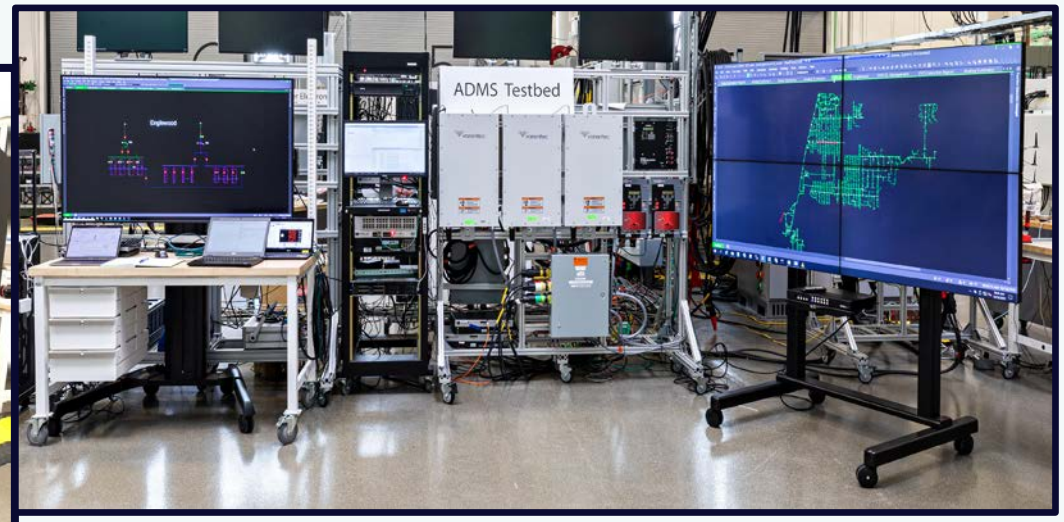
DERMS Overview

- ESIF Users
  - NREL researchers
  - Industry, academia, government
- Distributed Energy Resource Management Systems (DERMS) Vision
  - An end-to-end testbed enabling both demand-side and grid-level interactive use cases
  - Multi-layer architecture in an experimental environment
    - Combines hardware with simulation capabilities for hardware-in-the-loop (HIL)
    - Leverages DERMS and Advanced Distribution Management System (ADMS) functionality for complex controls
  - ARIES asset, establishing novel lab capabilities to support technology development, industry, and collaborators

Hardware-in-the-Loop Spotlight: Digital Real Time Simulation

Opal-RT Engines

RTDS Novacor Racks



ADMS Testbed

- *Power and energy system simulators drive hardware in the loop modeling, real-time*
- *Building block for scalable lab and operational scenarios*
- *Power systems studies, microgrids, cosimulation*

Photos by NREL

Electrical Spotlight: Energy Loads and Storage

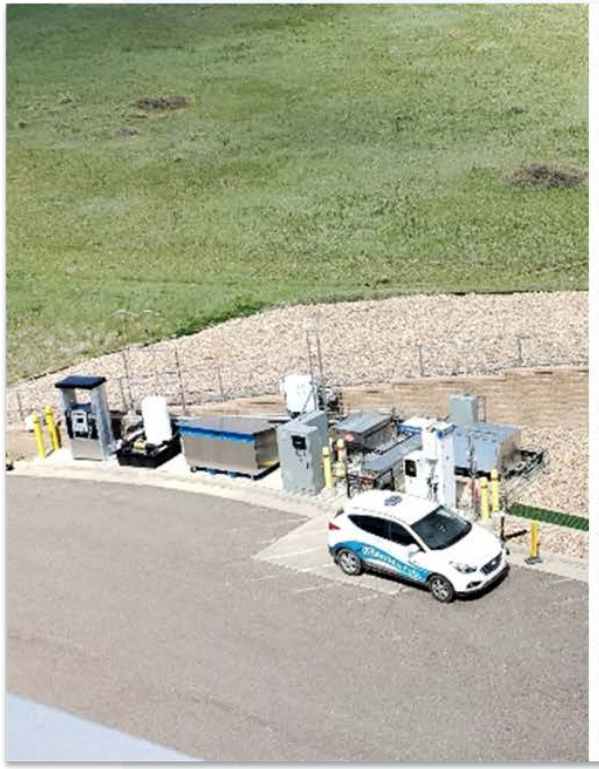
- Loadtec 250-kVA load banks

- Vehicle charging capacity 350-kW
- Emulated thermal loads and commercial building automation systems

- *Distributed modern electricity loads (buildings, vehicles, DER)*
- *High-power, high-resolution load emulators for dynamic response*
- *Interchangeable with system controllers; metered with feedback to real time simulators and/or data management systems*

Photo credit: NREL

Hydrogen Spotlight



- *1.25 MW PEM Electrolysis*
- *1.0 MW PEM Fuel Cell*
- *600kg H2 storage*
- *Light-, medium-, heavy-duty vehicle fueling station*
- *Compression and dispensing performance testing*
- *Biological fermentation of CO2 and H2 for renewable natural gas*

Photo credit: NREL

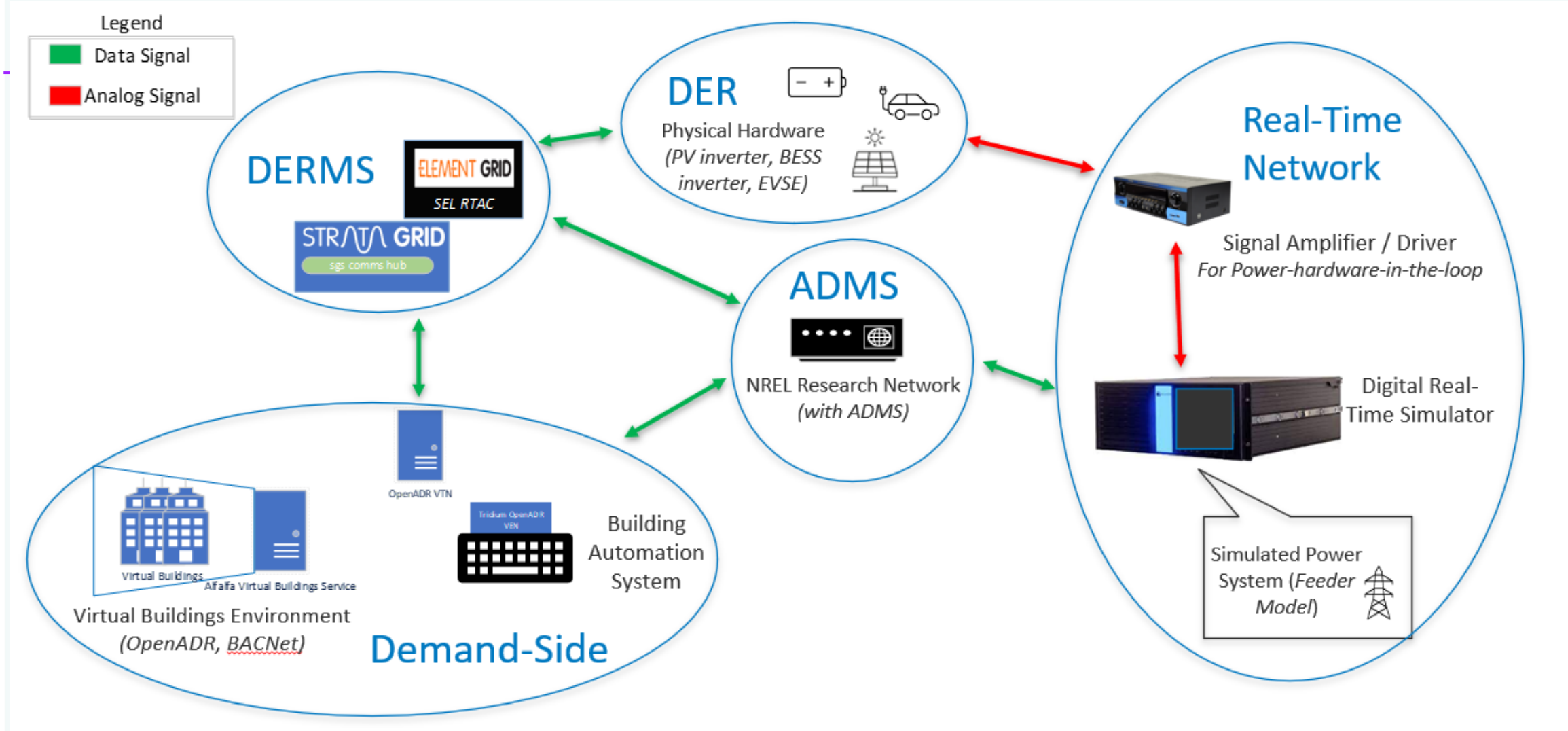
DERMS: A State-of-the-Art Grid Control Software Platform

- NREL has partnered with **Smarter Grid Solutions** to deploy and configure a laboratory-based Distributed Energy Resource Management System **(DERMS)**.

- The DERMS will allow flexibility for **evolving devices, architectures, and system interfaces**, to sustain both real and emulated pathways, by integrating **real and simulated hardware,** actual or replicated **customer programs, ADMS,** and **NREL research networks**. The project aspires to enhance U.S. Department of Energy research outcomes and provide tangible benefits to external partners by realizing DERMS functionalities.

- NREL DERMS research includes industry providers as well as in-house DERMS algorithms. The DERMS will become a supported capability of ESIF research infrastructure to propel industry and DOE ARIES initiatives.

DERMS: Use Case in Buildings Automation



Graphic by NREL

DERMS: Initial Research

- **Enable DERMS Connection to Building Automation System (BAS).** Optimize building energy usage and space conditioning for occupants. Enable pricing and/or performance validation. Reduce risk for deployments of devices, demand flexibility algorithms, and communications network(s).
  - VEN on Tridium BAS; controlling virtual buildings over OpenADR/BACNet (Alfalfa)
  - OpenADR messaging (loadshed, peak pricing, time-of-use pricing, direct control)
  - Explore program enrollment and device dispatch
  - Commercial scale buildings, complex models with equipment-level granularity.
- **Enable DERMS Connection to Distribution System Components.** Optimization and control of modeled distribution feeder with tap changers and protection. Utility and residential-scale circuits including real and virtual Level 2 chargers, PV, storage, and DER aggregator(s).
  - 30kW PV/Battery inverter
  - ADMS
  - Scale up the model, add/interchange connected devices, microgrid controllers, and/or aggregators

Smarter Grid Solutions

The SGS Mission

To provide the software that optimizes distributed energy in a successful transition to an economic, zero carbon electricity system.

Smarter Grid Solutions

SGS products deliver real results for customers and the environment

GW Scaling of DER Management

Proven & Trusted Technology Partner

$B Grid and Market Value Created

Smarter Grid Solutions develops and delivers Distributed Energy Resource Management System (DERMS) software that allows energy companies to monitor and control their portfolio of Distributed Energy Resources (DER) and interface them to grids and markets.

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Smarter Grid Solutions - DERMS Products

Products Based on Advanced Technology Platform

STRATA GRID

Grid DERMS for Distribution Utilities to manage technical issues created by DER and avoid expensive, slow and environmentally impactful grid upgrades. **Aggregator DERMS** to optimize DER and demand side programs.

Cirrus FLEX

VPP DERMS for DER Fleet Owners / Operators, Battery OEMs, local authorities and industrial & commercial customers to monetize flexibility from their assets in energy markets.

STRATA RESILIENCE

Microgrid DERMS for Distribution Utilities, developers, communities and local authorities to provide energy and power security.

ELEMENT FLEX
ELEMENT GRID

Edge DERMS for local connectivity and to provide grid edge optimization and control capability linked to Fleet / Utility / Microgrid DERMS.

NREL – SGS Partnership

Products Based on Advanced Technology Platform

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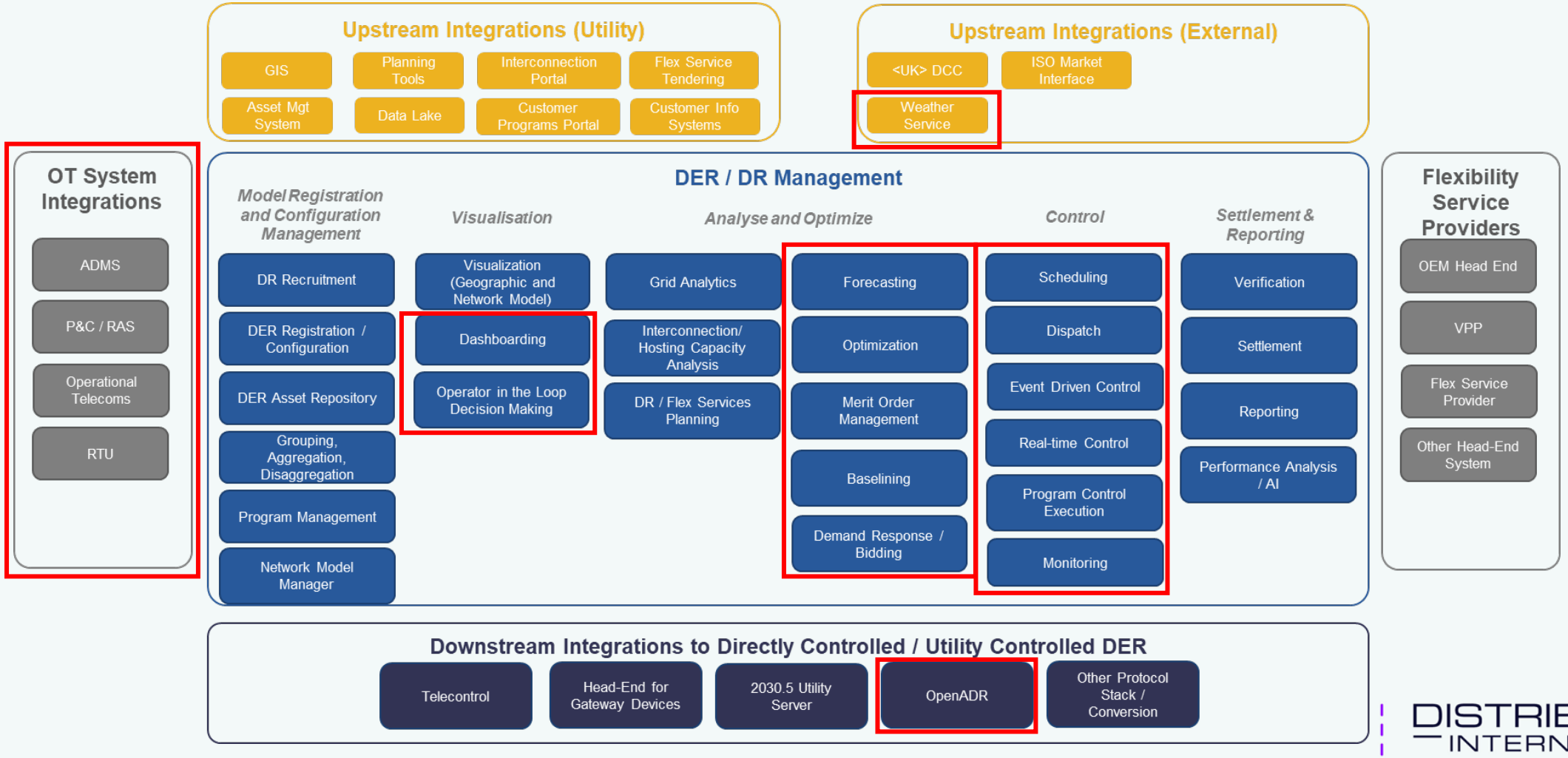
Potential NREL - SGS DERMS Integrations



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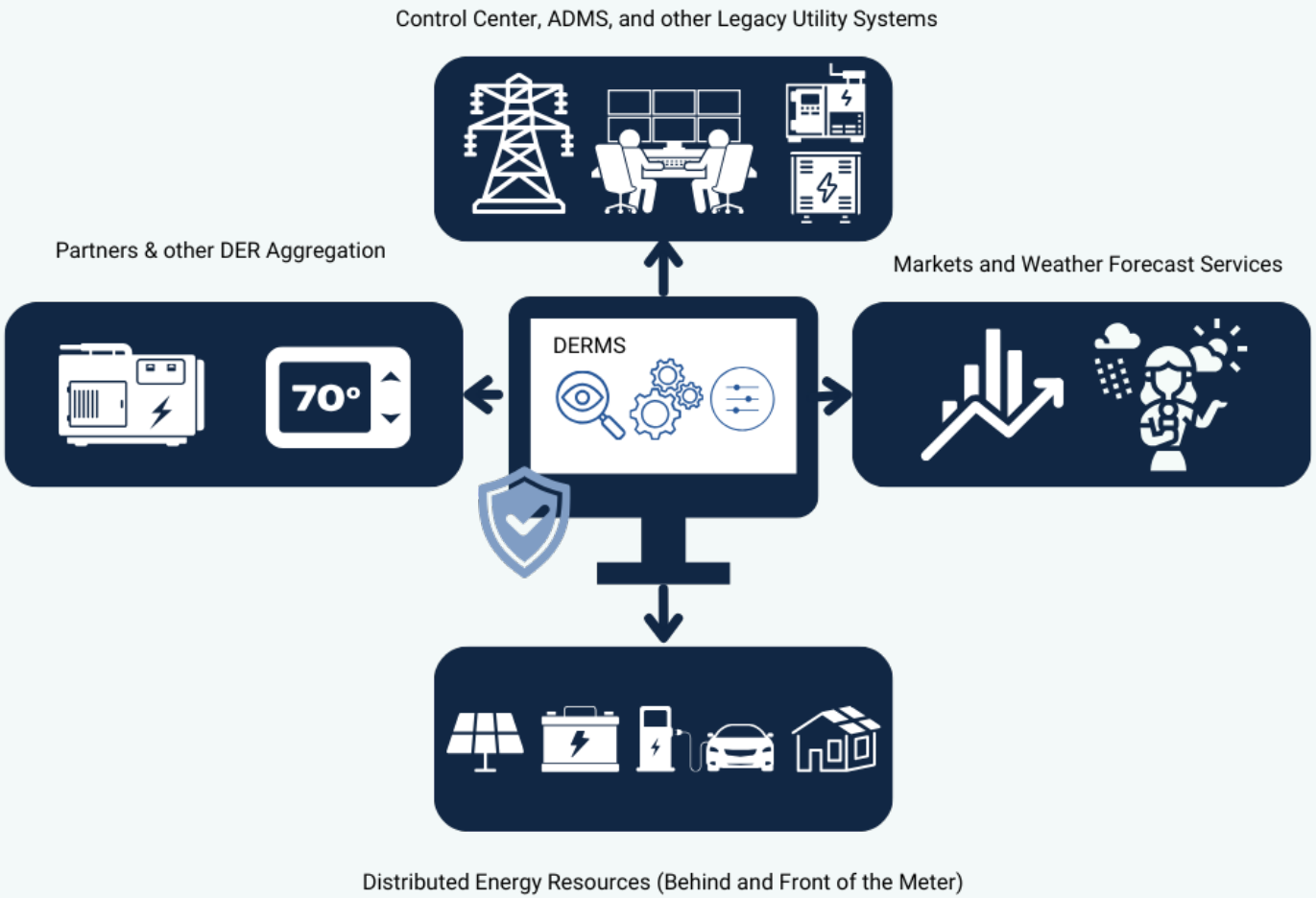
Strata Grid Integrations

- Strata Grid can deliver results on its own or as part of a wider utility ecosystem
- We can integrate and coordinate with a wide range of new or existing utility systems including:
  - **OT Systems** such as ADMS, SCADA, RTUs
  - **Upstream integrations** such as Planning tools, markets, weather forecasting services
  - **Downstream integrations** via a wide range of standard protocols and aggregators



DERMS: Potential Research Areas

- **Demand-Side Enhancements**
  - Additional configurations (networks, communications protocols)
  - Increased scale and complexity of connected devices and buildings
  - Optimize Demand Response (DR) dispatch using wholesale power markets and Locational Marginal Pricing (LMP) or similar
  - Incorporate physical metering equipment, real EVSE and/or models, and other real hardware
- **Distribution System Applications**
  - Incorporate hydrogen and/or thermal assets for increased complexity of DERs and microgrid research
  - Leverage DERs for planning and operations (ancillary services, load support, Virtual Power Plants)
  - Support energy market operations and financials for DER assets
  - Explore protection schemes including coordinated feeder protection
  - Analyze variations in communications pathways through virtual networking
  - VVO, CVR, and FLISR
  - Expand protocols (DNP3, Sunspec Modbus, OpenADR, Multispeak) for interoperability

Partnering with NREL and SGS

Work With Us:

- ***www.nrel.gov/aries/work-with-us.html***

Utilizing NREL's Strata Grid test bed installation, users can:

- De-risk integrations
- Gain comfort in DERMS capabilities
- Try different approaches to DERMS implementation
- Test new DERMS use cases

ARIES User Calls

User Call: Advanced Distribution Management System Test Bed Vehicle-Grid Integration

NREL is accepting proposals for projects that require our Advanced Distribution Management System Test Bed for Electric Vehicle to Grid Integration. Find out how to apply.

Photo credit: NREL

NREL Resources

For more information on NREL's ESIF and ARIES, please visit:

- NREL.gov/aries
- NREL.gov/esif
- 2023 ARIES Annual Report
- ESIF Stewardship Summary

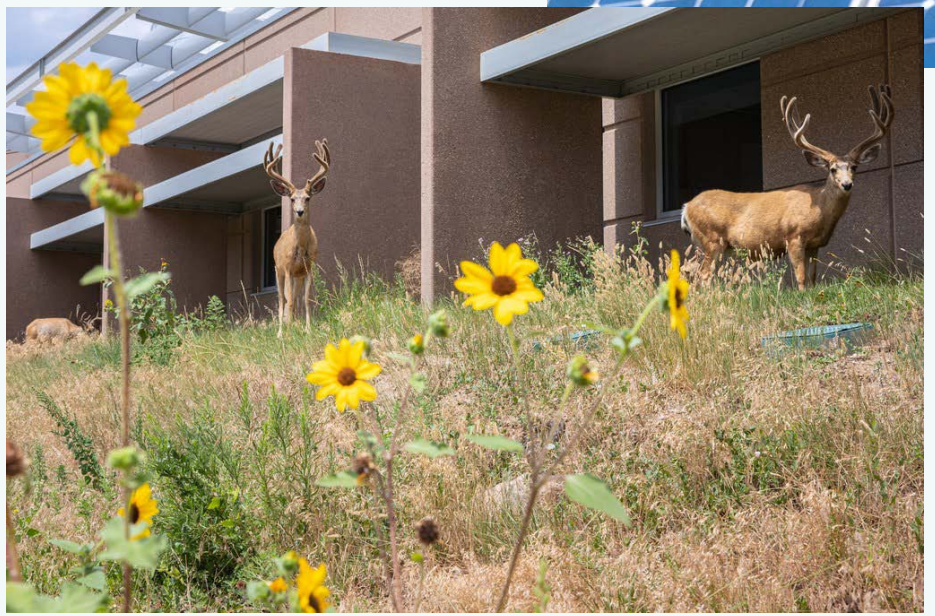


Photo credit: NREL

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NREL Transforming ENERGY

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