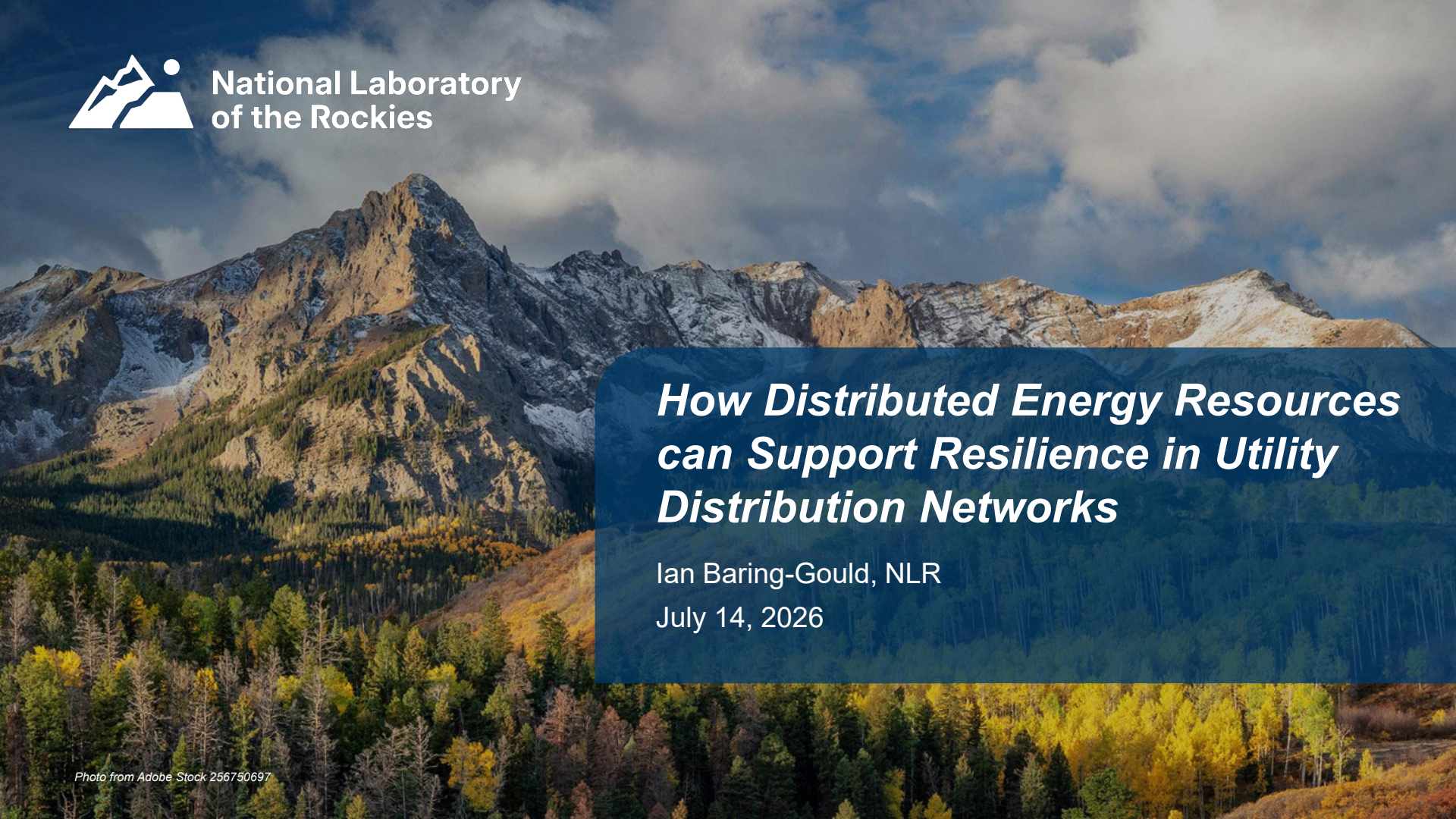


National Laboratory of the Rockies

How Distributed Energy Resources can Support Resilience in Utility Distribution Networks

Ian Baring-Gould, NLR

July 14, 2026

Photo from Adobe Stock 256750697

Agenda

1. Introduction to Distributed Energy Resources
2. National Laboratory of the Rockies Tools
3. Examples of Utility Engagement

What are Distributed Energy Resources (DERs)?

- A DER is an energy resource located near customers that can supply some or all of local power needs.
- Examples of DERs include:
  - Dispatchable generators (diesel, natural gas, propane)
  - Solar photovoltaic (PV)
  - Wind
  - Combined heat and power (CHP)
  - Energy storage
  - Demand response (DR)
  - Electric vehicles (EVs)
- Dispatchable or controlled loads are generally not considered, but are common in microgrid systems



Photo by Laura Beshilas, NLR 88841

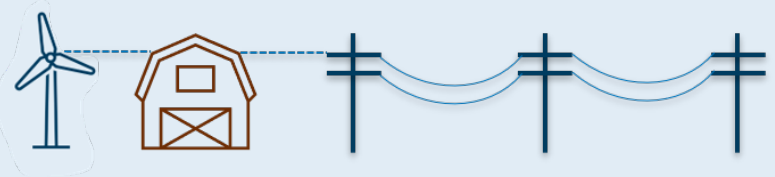


Photo by Josh Bauer, NLR 94720

DER Integration Types

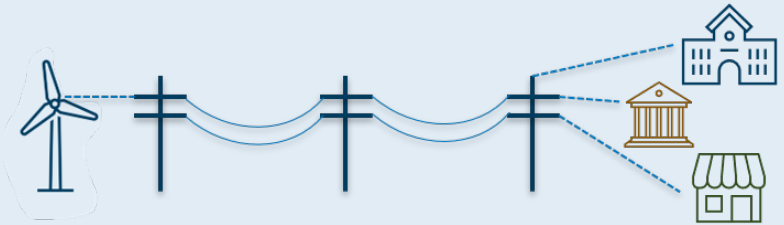
Behind the meter

- DERs can be installed **on-site** to power a home, farm, school, or facility.
- Excess power produced **on-site** may be sold to utility through net metering.



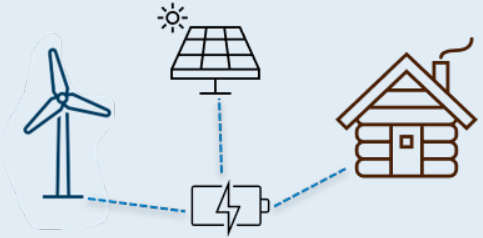
Front of the meter

- DERs can also feed electricity into the grid before it reaches **nearby** customers.
- Connected to distribution lines to serve **nearby** energy needs.



Off-grid

- DERs can also power remote homes or facilities.
- **Not connected to the grid.**



Options to Improve Resiliency

- **Grid Improvements** – strengthening the grid in areas where damage is possible or expected (hardening, undergrounding, etc).
- **Generation Disbursement** – power generation that is more likely to provide service when needed.
- **Resiliency Hubs** – defined locations designed to provide key services to a community members during normal times but also during disruptions and recovery, typically includes back-up energy services.
- **Grid Isolation** – isolating from the main grid in times of need (microgrids).
- **Critical Energy Service Reductions** – reducing need for resilience, move critical services to more secure locations, don't build in vulnerable locations.
- **Energy Service Alternatives** - transitioning to more resilient methods to meet end needs – alternative lighting, locally sourced heating (wood), improved building design.

Tools to Support Resiliency

Hazard Management Is More Than Just Physical Hardening

Strategic combinations provide the best defense against all hazards, wildfire and beyond

GRID HARDENING

- Undergrounding and partial burial
- Covered conductor
- Pole replacement and strengthening
- Line rerouting, redundancy, or removal
- Substation hardening
- Hazard-resilient equipment replacement
- Circuit sectionalizing

SITUATIONAL AWARENESS

- Localized weather stations
- Monitoring cameras, including Artificial intelligence (AI)
- Real-time fault detection
- Enhanced sensing (e.g., AMI, SCADA)
- Temperature, vibration, and corona detection sensors
- Real-time command center

PREVENTION

- Vegetation management
- Vegetation mapping
- Aerial and infrared (IR) inspection
- Increased inspection
- Pole testing and inventorying
- Animal guard devices
- Arc suppression and prevention technologies

OPERATIONAL

- Public safety power shutoffs (PSPS)
- Suspend auto-reclose settings
- Adaptive protection
- Microgrid islanding
- Pre-positioning of equipment and crews
- Critical customer hubs (CCHs)
- Dynamic line thermal rating

PROGRAMS AND POLICY

- Customer resiliency programs
- Innovative funding and financing for hardening
- Hazard mitigation investment recovery mechanisms
- Integrated grid planning for multiple hazards
- Performance-based regulation tied to reliability/ resiliency metrics

COMMUNICATION

- Pre-event coordination with emergency responders
- PSPS customer communications
- Public outreach and coordination
- Multi-platform communications (e.g., text, app, phone, radio)
- Educational campaigns

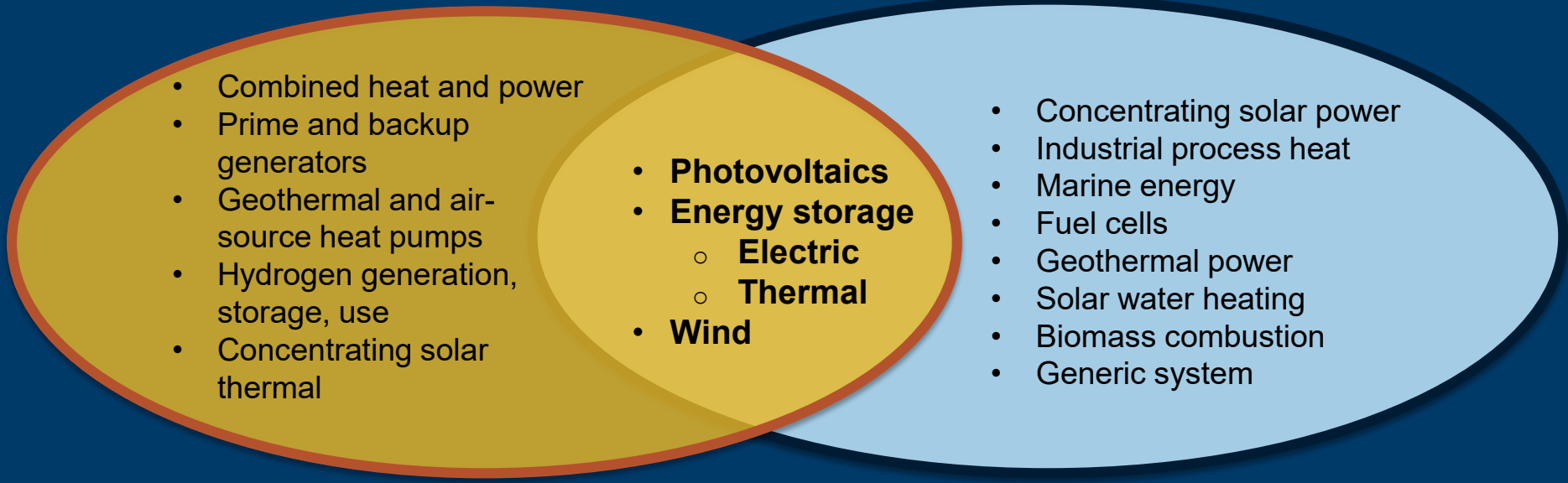
ANALYTICS

- Predictive risk scoring
- Risk mapping
- AI and machine learning for hazard prediction and detection
- Infrastructure fragility models
- Probabilistic risk assessment

References: Hawaiian Electric (2025–2027 Wildfire Safety Strategy), Panteli et al. (2017), PG&E and SCE Wildfire Mitigation Plans, National Academies: Enhancing the Resilience of the Nation's Electricity System.

REopt Integration and Optimization

System Advisor Model



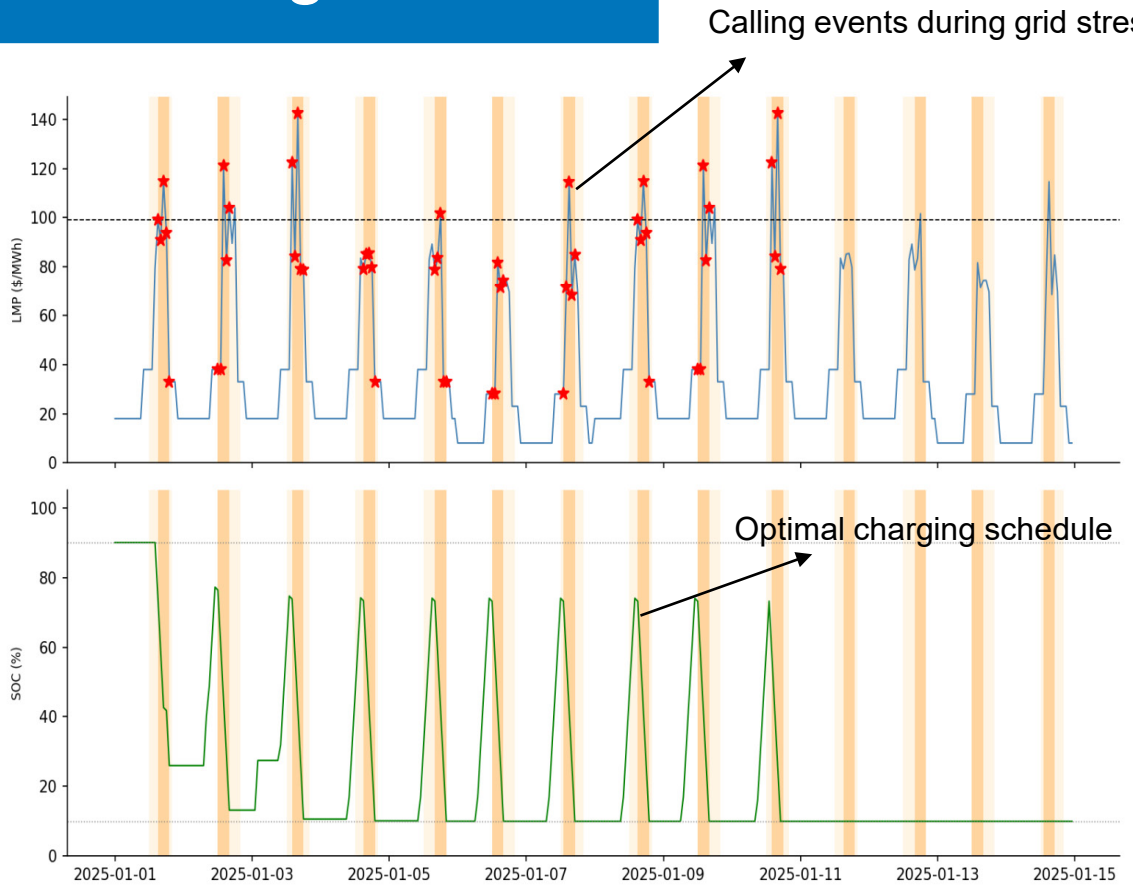
REopt technology focus: Behind-the meter and off-grid distributed energy technologies. Can evaluate combinations of any technologies available in REopt.

SAM technology focus: Behind-the-meter, front of meter PPA, merchant plant, community solar. GUI includes PV, wind, electric storage, and fuel cell hybrids in various combinations. PV + storage can be AC or DC connected. Four default hybrid combinations, need programming expertise to evaluate other hybrids.

* New releases of both tools may include additional technologies and capabilities.

Implementation in H2Integrate

- The central challenge is operating a battery optimally given each co-op's unique pricing schedules and demand patterns.
- H2Integrate addresses this with an automated dispatch capability that targets and reduces peaks during high price periods.
- Benefits the G&T as well as the co-op.
- The platform is designed to be generalizable. As we expand, any co-op can adopt this solution without custom development.



Examples of Utility Engagement

Tri-State G&T Technical Assistance Focus

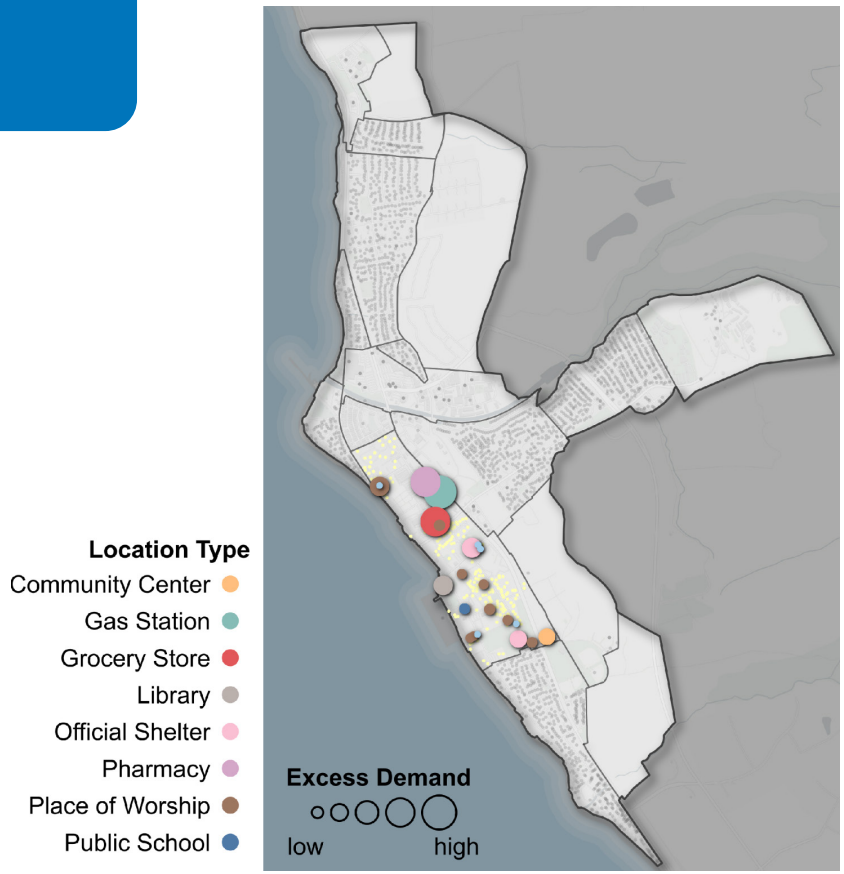
- **Peak Assessment:** Determines when member and Tri-State peaks coincide, directly impacting capacity value, infrastructure utilization, and system-wide cost savings from distributed wind-plus-storage.
- **Charge/Discharge Strategy:** Defines how storage is operated to reduce peaks, support reliability, and capture value, while avoiding unintended creation of new billable peaks or suboptimal dispatch outcomes.
- **Dispatch and Control Hierarchy:** Establishes how competing objectives (peak reduction, market signals, reliability, and operational constraints) are prioritized to ensure consistent, system-optimal operation.
- **Charging Costs and Auxiliary Loads:** Accounts for efficiency losses and thermal management energy needs that reduce net system benefit and materially affect realized project economics.
- **Cost Allocation Structures:** Evaluates how assigning charging and operating costs between members and Tri-State influences dispatch behavior and system value.

Where these services are located is also important

Where services are located, combined with how long a power disruption occurs should drive power system development choices



Flooding damage in rural southwestern Alaska impacted by Typhoon Halong in early October 2025 *forced whole communities to be evacuated, causing major personal and community disruption*



Consideration of services provided through a microgrid in Lahaina, HI

Utility and Grid Operator Technical Assistance Program

Utility and Grid Operator Technical Assistance

NLR provides no-cost technical assistance to support utility and grid operators in modernizing systems and planning for major industry challenges and opportunities.

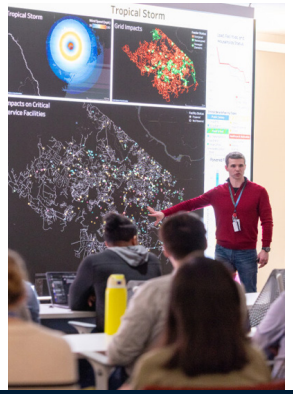
Key Assist provides utilities and grid operators with access to national lab facilities, research platforms, and world-class researchers.

Interconnection Assistance is supported by DOE's Interconnection Innovation e-Xchange (i2X) to help address their interconnection needs.

Rolling Technical Assistance provides 100 hours of subject matter expertise from NLR, Pacific Northwest National Laboratory, or Lawrence Berkeley National Laboratory

https://www.nlr.gov/state-local-tribal/utility-grid-operator-technical-assistance







Technical Learning and Exchange

NLR provides recordings of webinars and workshops to support technical learning for utility partners as well as a forum for peer learning and exchange.

Key topic areas: *Advanced distribution management systems; Cybersecurity considerations for distributed resources; Weather driven resilience for distribution systems; Transmissions and distribution coordination; Advanced load forecasting; Resource adequacy; Inverter-based resources; Microgrids, virtual power plants, and distributed energy resource management; Customer rate and tariff design; Large load management and grid planning; Integrated distribution planning; Distributed energy resource integration*

Insert the words "in part" if this work includes non-NLR authors

This work was authored by the National Laboratory of the Rockies for the U.S. Department of Energy (DOE), operated under Contract No. DE-AC36-08GO28308. Funding provided by Department of Energy Office of Critical Minerals and Energy Innovation. The views expressed in the article do not necessarily represent the views of the DOE or the U.S. Government. The U.S. Government retains and the publisher, by accepting the article for publication, acknowledges that the U.S. Government retains a nonexclusive, paid-up, irrevocable, worldwide license to publish or reproduce the published form of this work, or allow others to do so, for U.S. Government purposes.

Thank you

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