



# Installation of Long-Duration Vanadium Flow Battery for a Resilient and Cost- effective Microgrid

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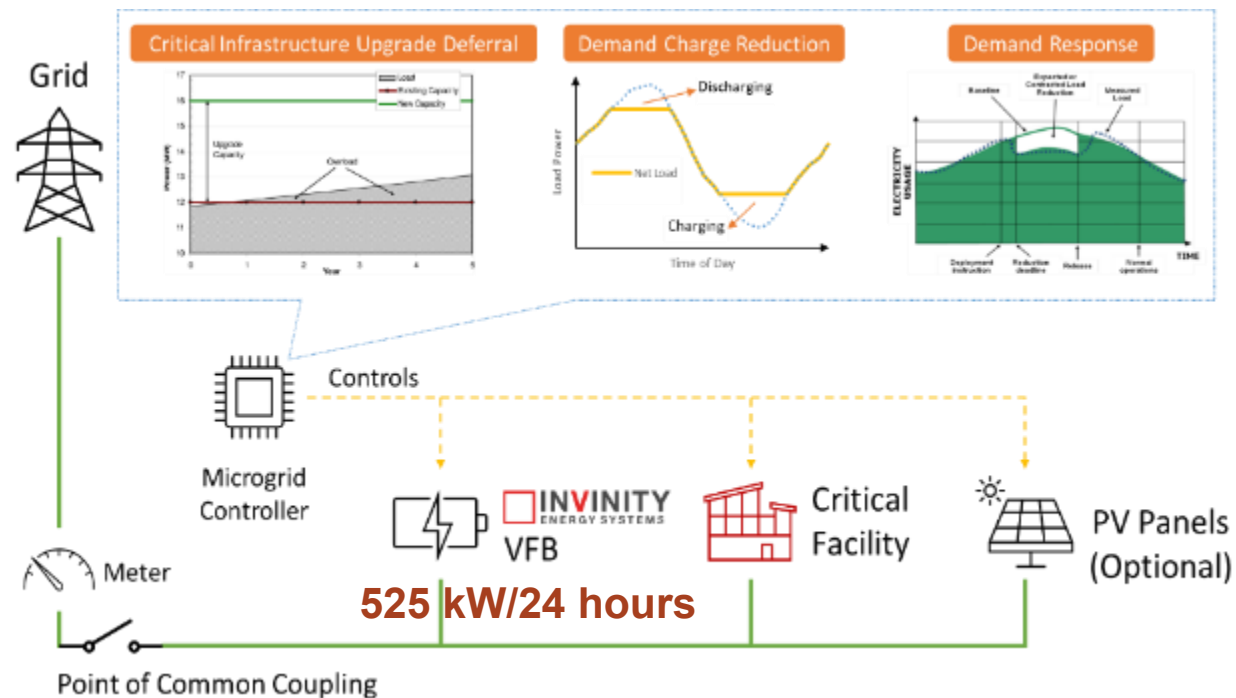


PNNL is operated by Battelle for the U.S. Department of Energy



# Project Synopsis

- **Objective:** install and validate a 24-hour vanadium flow battery (VFB) system to enhance resilience, improve flexibility, and reduce energy costs at PNNL's Richland campus
- **Technical Team:** PNNL, Invinity, City of Richland, and CleanTech Strategies, in collaboration with engineering and construction partners and various local stakeholders



May  
2024

Siting, Hazard Analysis, &  
Engineering Design

May  
2025

Manufacturing, Construction,  
Installation, and Integration

May  
2026

Ramp up, Testing, and Data  
Reporting



# Invinity's VFB Battery System

- VFB technology is a proven alternative to lithium-ion
- Invinity is a leader in VFB

**82**

**PROJECTS**

Across 15  
countries on five  
continents

**170**

**MWH**

Deployed,  
contracted or  
awarded

**152**

**EMPLOYEES**

R&D, Product  
Development and  
Manufacturing Focus

**81**

**PATENTS**

Granted or  
pending

**15+**

**YEARS**

R&D investment  
in product and  
manufacturing

**Invinity VFB Strengths**  
Modular platform designed for  
larger scale projects

**Modular  
Unit**

**Stackable  
Design**

**High  
Scalability**

**Turnkey  
Installation**



**CHAPPICE LAKE, AB**

8 MWh | PV integration + merchant trading



**SOBOBA FIRE STATION, CA**

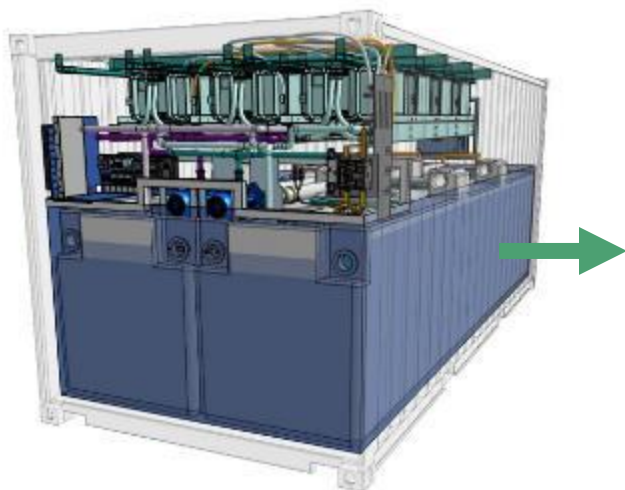
0.8 MWh | Microgrid + PV integration



**VIEJAS RESORT, CA**

10 MWh | PV + TOU optimization

# Path for Commercialization



## Transition from VS3 to *Mistral*

- ~~>5%~~ **10%** improvement in RTE
- ~~>30%~~ **40%** increase in energy capacity
- ~~~33%~~ **35%** reduction in cost

Mistral targets LCOS leadership while delivering commercially viable margins

COST TRAJECTORY

1. Deploy VS3 for vital experience and to reduce risk

2. Mistral development, a low-LCOS product by design

3. Mistral deployment, higher margins enabling profitability

	VS3-022 Today	Mistral in 2025
TRL	8	9
MRL	8	10
IRL	9	9

The proposed project will demonstrate a 24-hour system in a field environment for the first time

# PNNL Project: Speeding LDES Commercialization

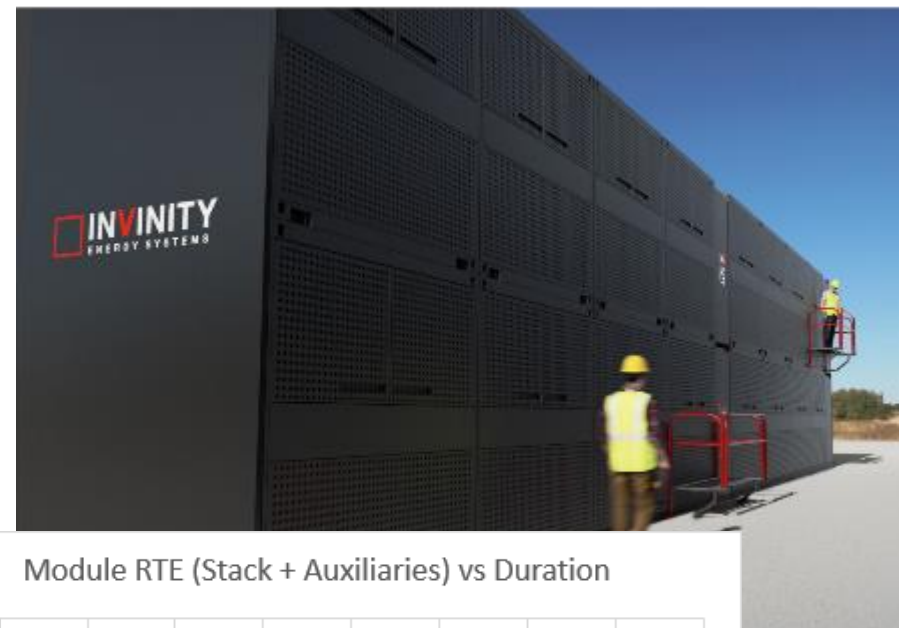
## Invinity VFBs in Commercial Operation:

- >30 MWh actively trading
- Services from sub-second ancillary services to multi-hour PV shifting and energy trading
- Validating 3+ cycle-per-day capabilities

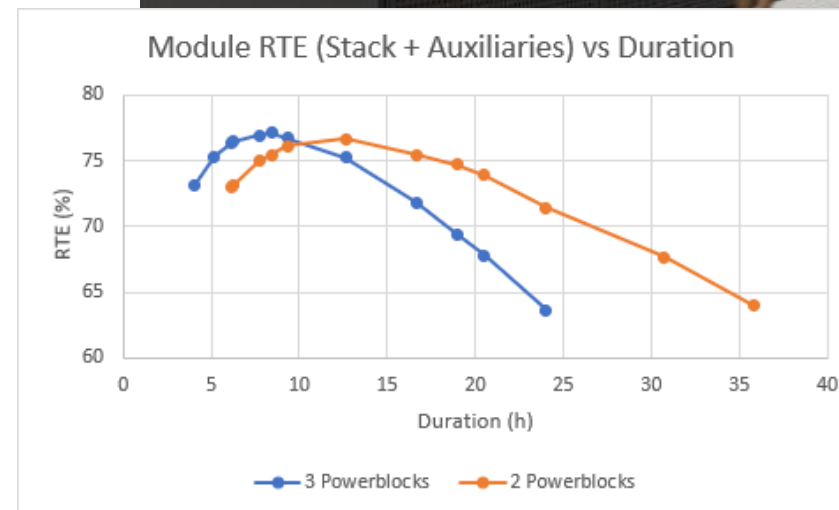
## At PNNL: Validating LDES Applications:

- In-field long-duration performance
- Test LDES-only use cases
- Harmonization alongside existing services
- Answering “Can’t you just install more short duration batteries?...”

Performance Curves for Standard →  
vs LDES Mistral Configuration



(above)  
Mistral  
Rendering

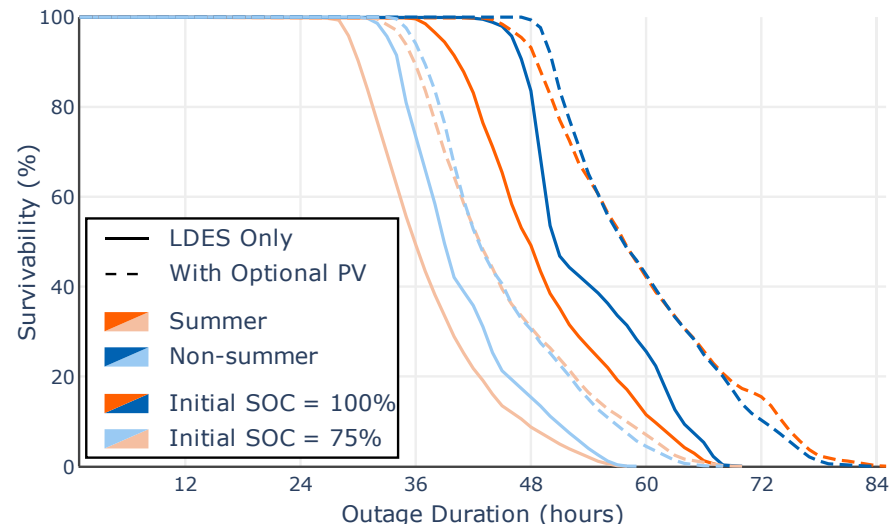




# Anticipated Resilience and Economic Benefits

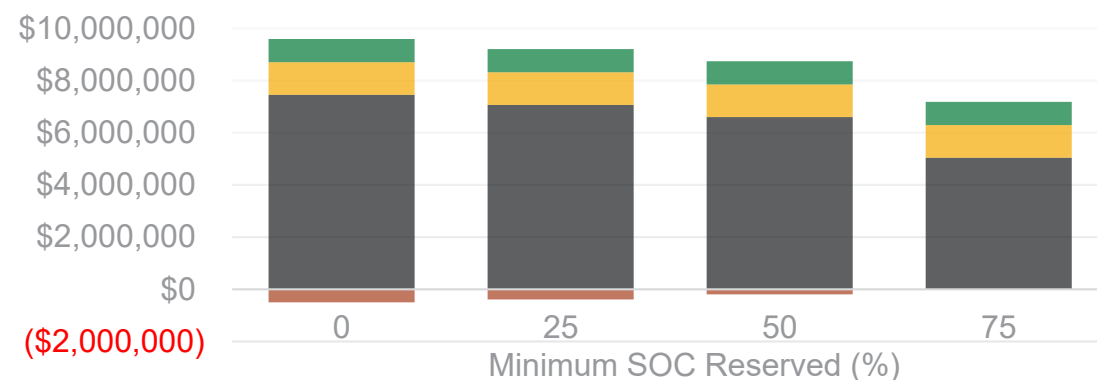
## • Resilience Performance

- Maximum outage durations with at least **90% survivability** vary from **13 to 50** hours, depending on siting locations, initial state of charge (SOC), and season
- The probability to survive a random **24-hour** outage is over **97%** in several siting scenarios



## • Economic Benefits

- \$7.2 million** from bundling secondary use cases (with 75% energy reserved for resilience application)
  - ✓ Deferral of critical infrastructure upgrades
  - ✓ Energy cost savings
  - ✓ Demand response



■ Critical Infrastructure Upgrade Deferral 
 ■ Transmission Charge Reduction 
 ■ Demand Charge Reduction 
 ■ Load Shaping Charge Reduction

# Thank You

**Energy Storage @ PNNL**

<https://www.pnnl.gov/energy-storage>

**Invinity Energy Systems**

<https://www.invinity.com>

**OED LDES Program**

<https://www.energy.gov/oced/long-duration-energy-storage>

