



Lessons Learned from the Arlington Microgrid

Lighting Design Lab
February 10, 2026

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**SNOHOMISH
PUD**
Energizing Life In Our Communities

Agenda

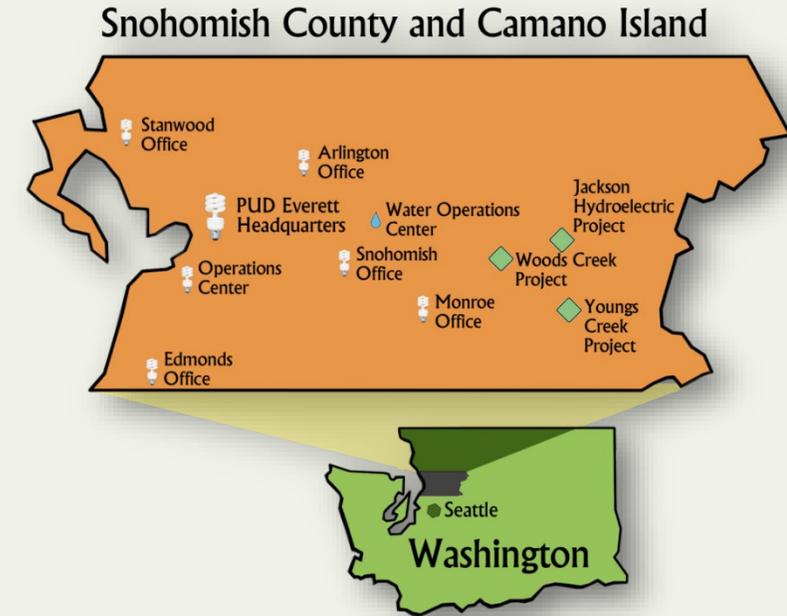
1. Who is Snohomish County PUD ?
2. Where does our electricity come from ?
3. What have we done so far and learned from ?
4. Arlington Microgrid and lessons learned.
5. What is next?

About Snohomish County PUD

- Snohomish County & Camano Island
- Largest PUD in WA State
- **Began operation in 1949**
- Serves population of about 907,000
- **367,000 customers and growing**
- ~ 94% of our power is from Bonneville Power Administration
- **3-Elected commissioners**

Five hydro-electric systems

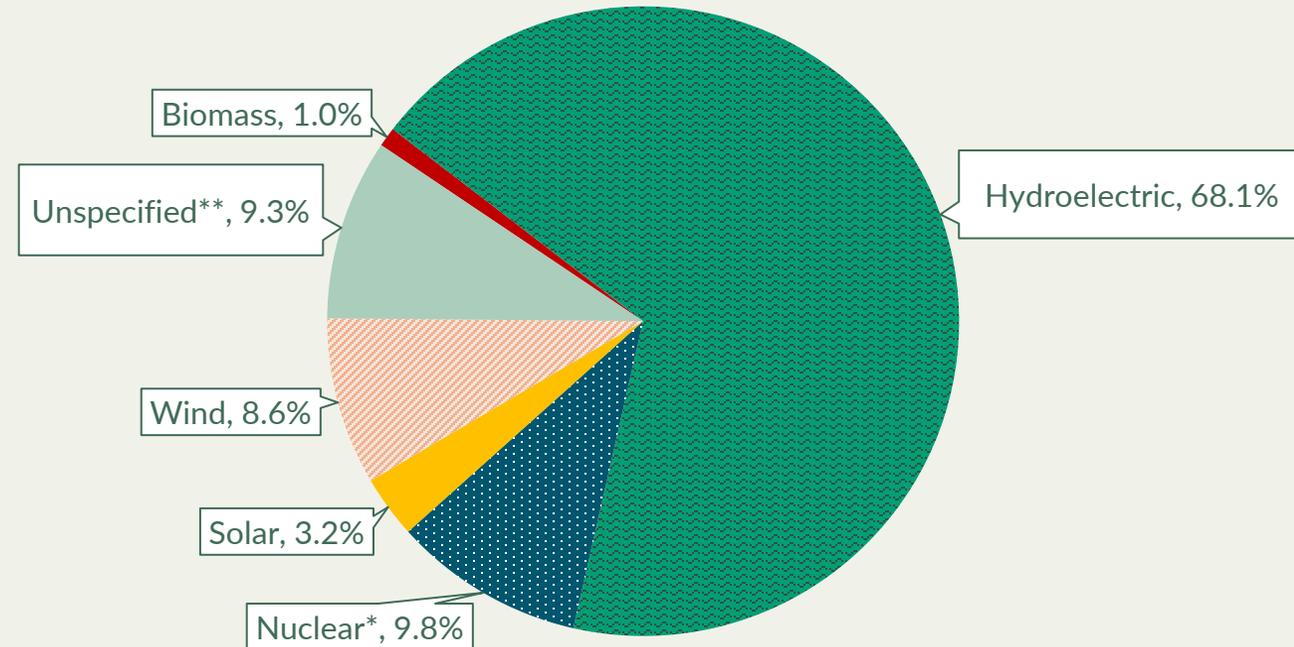
Jackson -	100 MW
Young's Creek -	8 MW
Hancock Creek -	6 MW
Calligan Creek -	6 MW
Woods Creek -	650 kW



2024 District Generation Resources

- Average Load = 900 MW | Winter Peak = 1,620 MW
- BPA – 66.0 % (Block Slice Contract)
- Market – 21.8 %
- Contracts – Wind – 5.3%
- PUD – 6.9%
 - Customer Rooftop Solar – 48 MW
 - Hampton Mill (Darrington) – 2 MW
 - PUD Hydro – 130MW
 - PUD Solar – 875 kW
 - PUD Dairy Digester – 675kW

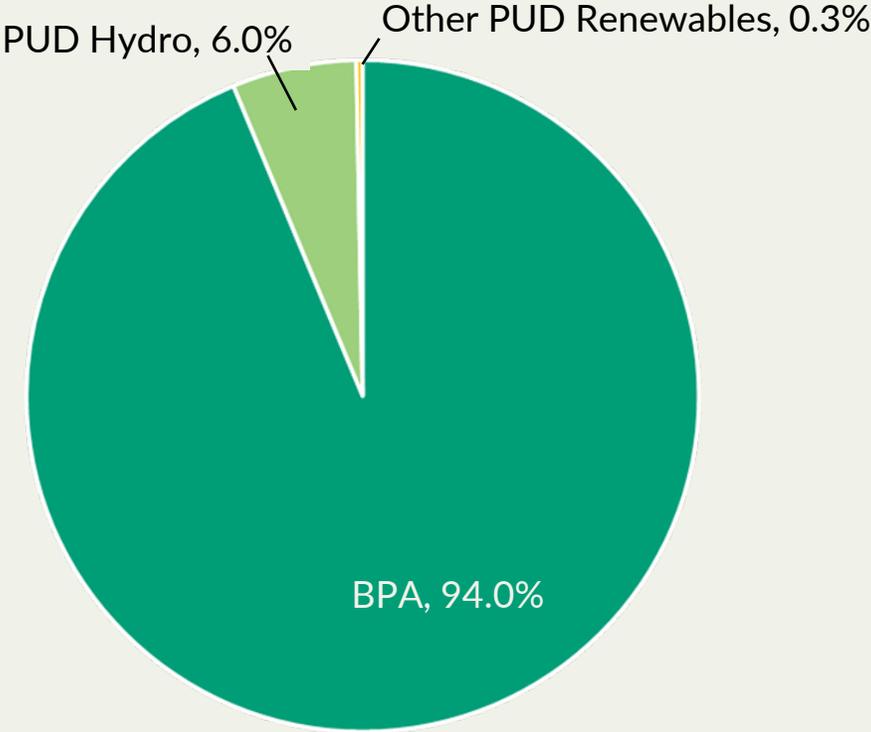
PUD Energy Sources



Oct. 1, 2025 - District Generation Resources

- Average Load = 900 MW | Winter Peak = 1,620 MW
- BPA – 94.0 % (Load Following Contract)
- Market – 0 %
- Contracts – Wind – 0%
- PUD – 6%
 - PUD Hydro – 130 MW
 - Customer Rooftop Solar – 48 MW
 - Hampton Mill (Darrington) – 2 MW
 - PUD Solar – 875 kW
 - PUD Dairy Digester – 675 kW

Forecast 2026 PUD Power Supply



MESA 1



- **MESA 1A – Lithium Ion**
 - Nickel Manganese Cobalt (NMC)
 - 2MW / 1MWh
 - Project Complete February 2016
 - Washington Clean Energy Funds
 - Decommissioned and recycled in 2025

MESA 2 – decommissioned



- Vanadium Redox Flow Battery
 - 2.2 MW / 8 MWh
- Constructed early 2017
 - WA State Clean Energy Funds (CEF1)
- Challenges
 - Inadequate availability
 - Mechanical (pumping) issues
- Decommissioned 2022

Clean Energy Center

North County Data Center

North County Local Office



12kV Electrical Distribution

MICRO GRID ↔ UTILITY GRID

480V Distribution

Vehicle to Grid (V2G) Controller

Solar Inverter with Grid Support Capabilities

Utility Interactive Inverter

Circuit Breaker with Relay Control

PCC (Point of Common Coupling)

Grid Tie Equipment



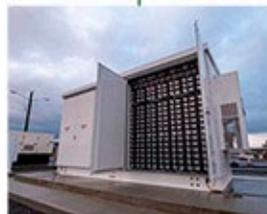
Electrical Grid



Electric Vehicles V2G



Photovoltaic System 500 kW AC



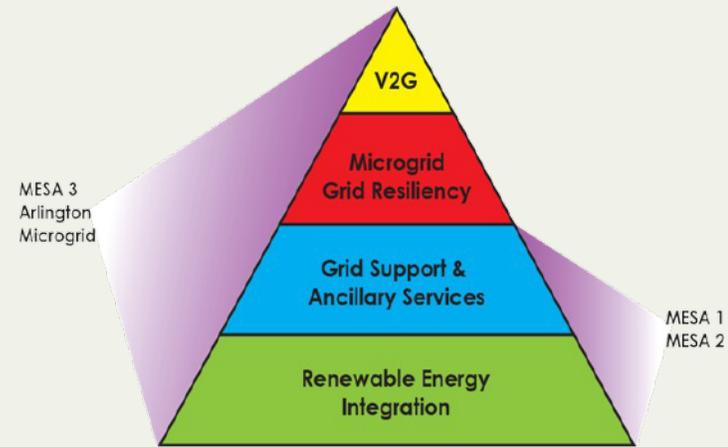
Energy Storage 1 MW / 1.4 MWh Lithium Ion



Emergency Generator 350 kW

Arlington Microgrid

The multiple uses of energy storage



Goals and Use Cases Proposed for Clean Energy Fund 2 Grant

- **Grid Resiliency and Disaster Recovery**
 - Provide partial back-up power to the Clean Energy Center, a redundant data center and the new North County Local Office. Test if this can support use as a back-up office site in the event of a regional disaster.
- **Renewable Energy Integration**
 - During normal operation, the battery will be used to demonstrate improved integration of an intermittent renewable energy resource - solar.
- **Grid Support and Ancillary Services**
 - Will be connected to the PUD's other two energy storage systems via DERO (Distributed Energy Resource Optimizer). This will allow the battery to be called upon to provide grid support when it is not being used for either of the above two uses.
- **V2G (Vehicle-to-Grid)**
 - Demonstrate how the rapidly growing number of electric fleet vehicles can be used to provide support to the grid.

Arlington Microgrid Project Timeline

Planning and Design

- CEF2 Grant: \$3.5M, June 5, 2017 to March 31, 2022
- University of Washington - Reports: June 1, 2017 to October 30, 2021
- Burns & McDonnell – Design: December 22, 2017 to December 31, 2021

Construction

- Phase 1: Site Work: Aug – Dec, 2018
- Phase 2: Solar: March – June 2019
- Phase 3: Equipment and Controls contract: 2019 – 2021
- Phase 4: Facilities – Clean Energy Center & Data Center: 2019 – 2020
- Phase 5: Microgrid Civil Construction: June 15 – July 20, 2020
- Phase 6: Microgrid Construction: April 2020 – Dec 2020
- Phase 7 : Commissioning - January - December 2021 (UW, PNNL and BPA)



2018 > North County (Arlington Microgrid) Site



April 30, 2019 > Solar on-line

<https://vimeo.com/331829273>

Community solar

- 500 kW_{AC} (615 kW_{DC})
 - Largest community solar in WA
- Community solar fast facts
 - 8100 solar energy units sold
 - 1 solar energy unit per 1/5 panel
 - \$0.06/kWh bill credit for 20 years + \$0.16/kWh WA state incentive for 8 years
 - \$120 units sold out in 14 days
 - Expected 20-year return \$186
 - About 1.8% of SnoPUD's customers invested
 - 10% of project set aside for low-income

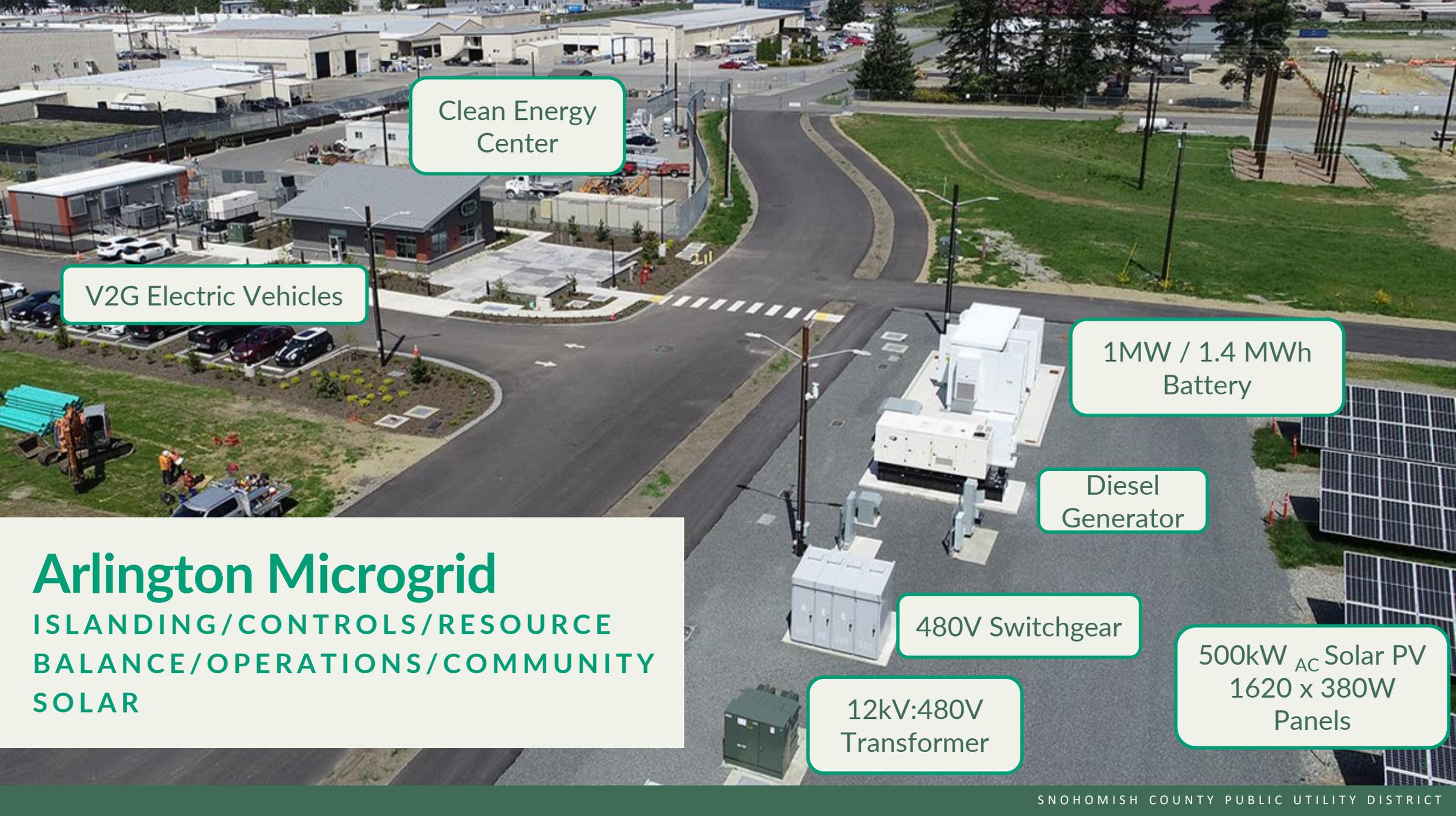




March 23, 2020 > Construction paused due to COVID.



June 1, 2020 > Restarting with social distancing



Clean Energy
Center

V2G Electric Vehicles

1MW / 1.4 MWh
Battery

Diesel
Generator

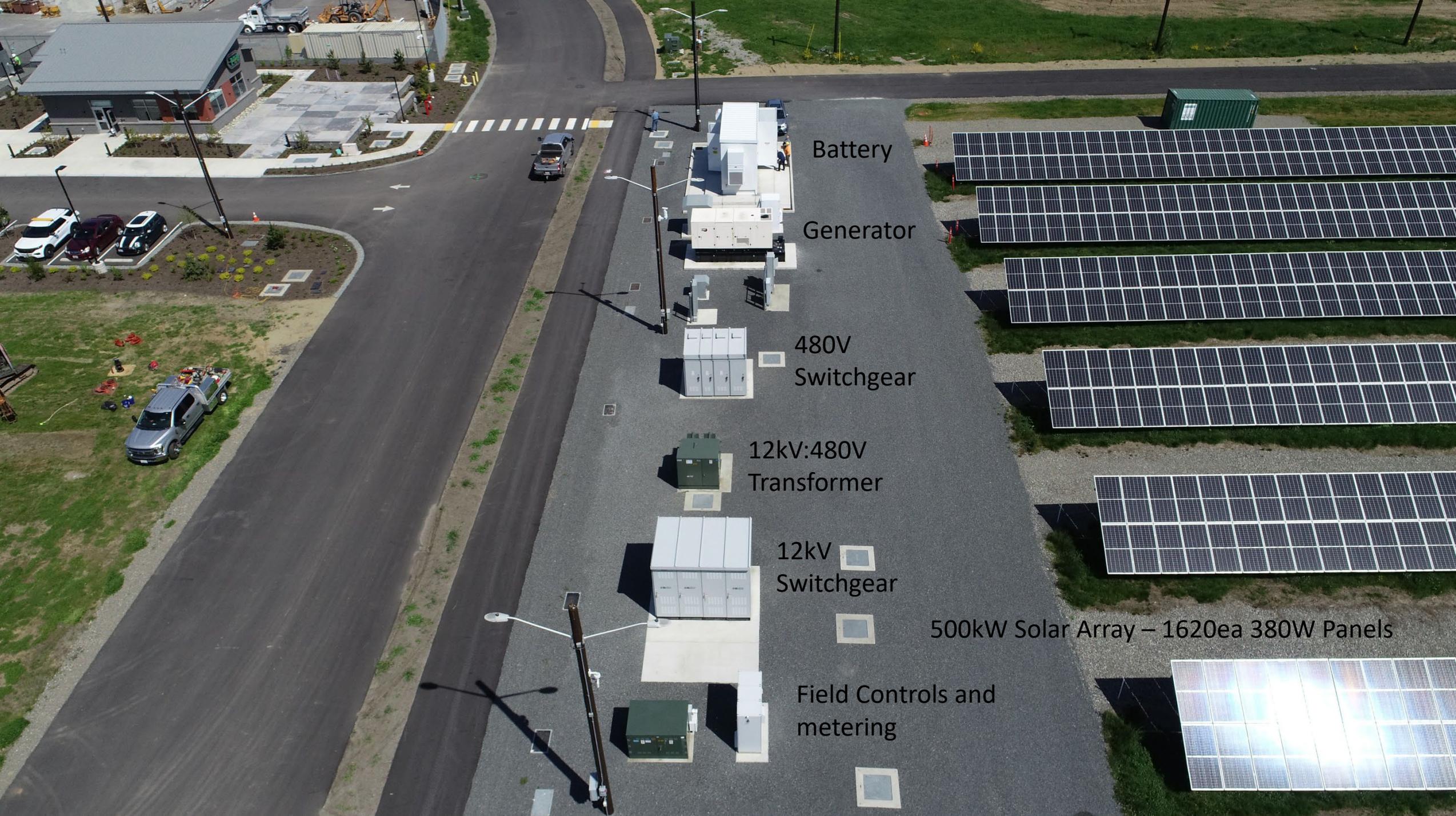
480V Switchgear

500kW_{AC} Solar PV
1620 x 380W
Panels

12kV:480V
Transformer

Arlington Microgrid

ISLANDING/CONTROLS/RESOURCE
BALANCE/OPERATIONS/COMMUNITY
SOLAR



Battery

Generator

480V
Switchgear

12kV:480V
Transformer

12kV
Switchgear

Field Controls and
metering

500kW Solar Array – 1620ea 380W Panels

November 17, 2020
Setting the Battery Container





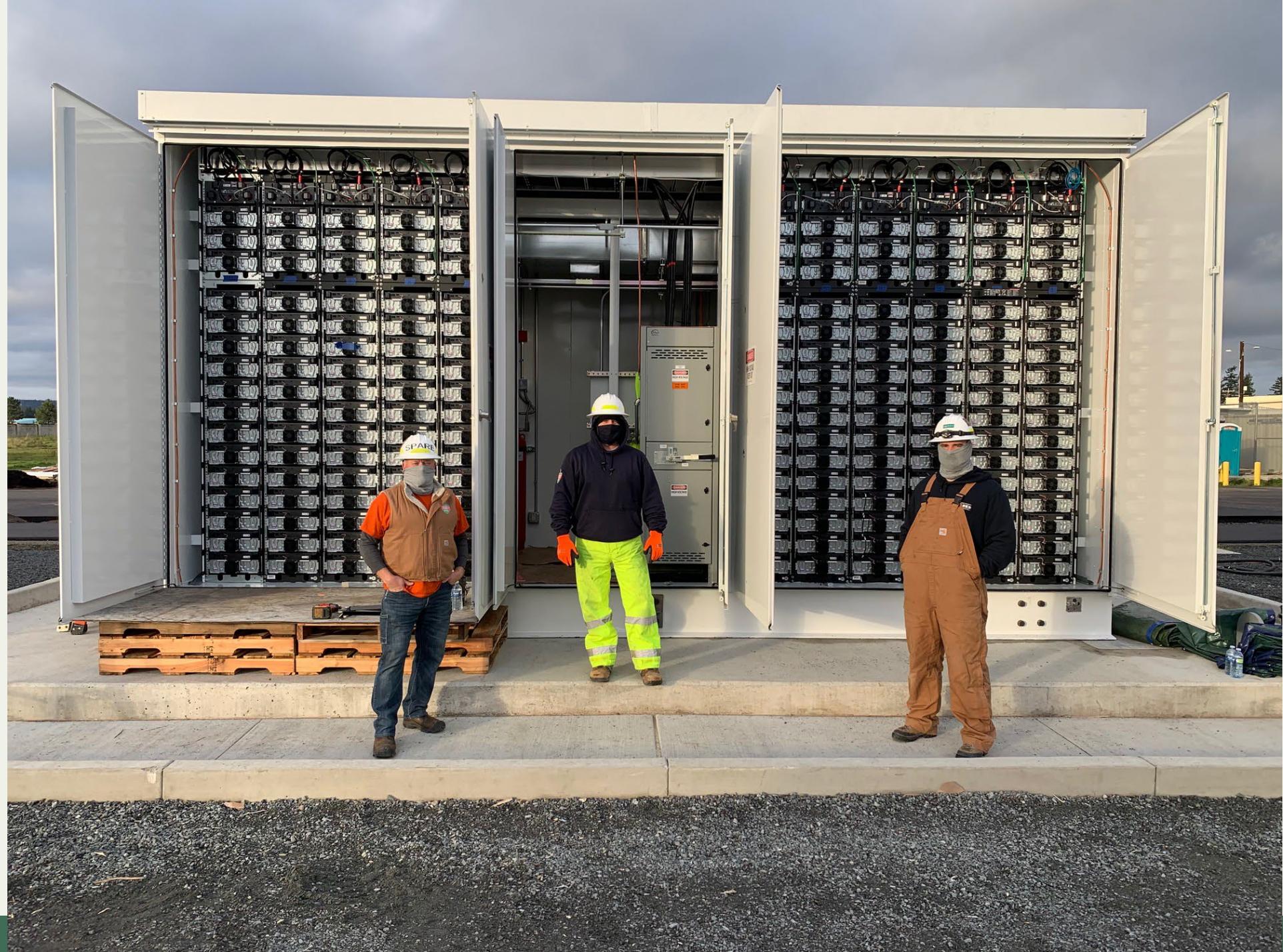
November 19, 2020 Installing Samsung Battery Modules

Battery Energy Storage System

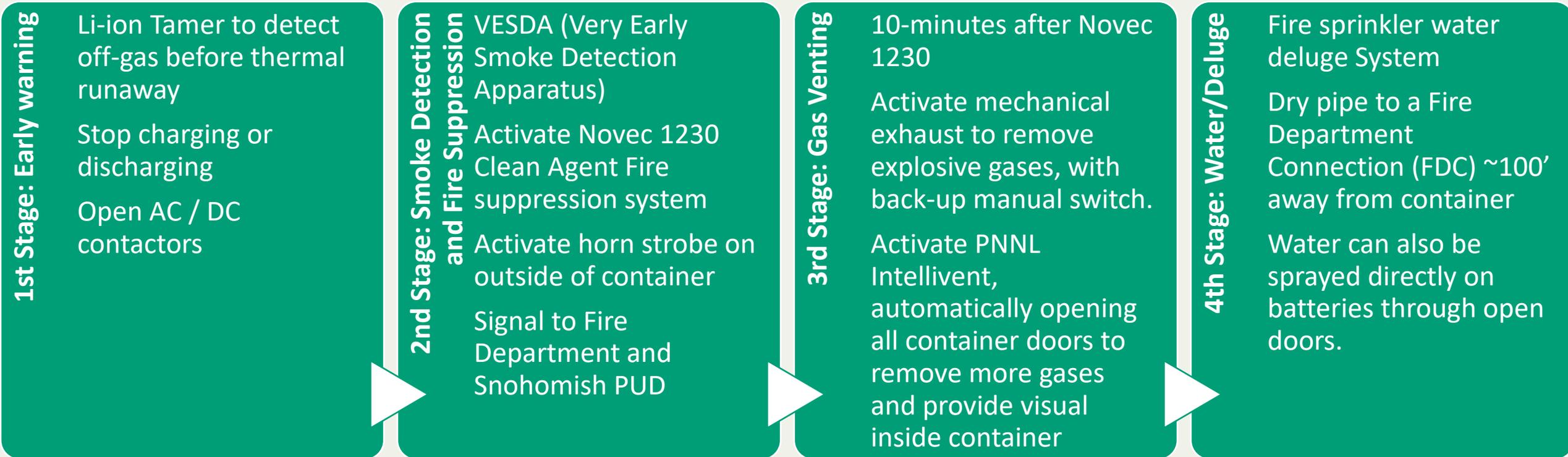
1MW / 1.4 MWh

Hitachi Controls and Battery Management System

Samsung Battery Cells
NMC Lithium Ion
(Nickel Manganese Cobalt)



BESS Safety: Four Stage System



BESS Safety: Design, Planning & Training

- Comprehensive System Level Approach
 - Select reputable, well-established vendors
 - Focused on quality
 - Focused on safety
- Continuous Training
- Proper environmental controls
 - Heating, cooling and humidity
- Engage Authorities Having Jurisdiction (AHJ)
 - Codes – NFPA 855
 - First responder training - Annual



Vehicle to Grid
(V2G) System

2 ea – Level 2
10kW, bi-directional
chargers

2ea – Nissan Leaf
40kWh and 62kWh

Mitsubishi Power
V2G Charger and
Communications

Hitachi-ABB
Control in microgrid
mode

Doosan Gridtech
Control when grid
connected



Arlington Microgrid – Services & Benefits

Grid Connected Operation

- Individual control of assets
- BESS
 - Renewable integration / solar smoothing
 - Energy arbitrage
 - Demand reduction
- V2G (vehicle-to-grid)
 - Grid support
- Solar PV
 - Energy export

Transition Capability

- Seamless islanding
 - Planned
 - Unplanned
- Seamless resynchronization

Islanded Operation

- 100% renewable operation
- Ancillary services in MG provided by GFM BESS
 - Inertia (frequency)
 - System strength (voltage)
- Hybrid operation of BESS, V2G, solar, and back-up generator for resilience
- Disaster support

Lessons Learned

- **Collaboration**
 - Microgrid systems are still complicated and require consistent maintenance and monitoring.
 - Choose a vendor with a solid track record of experience and longevity.
- **Battery Energy Storage System Safety**
 - Engagement with local first responders and code officials is important for success
- **Microgrid Modeling**
 - System Stability Modeling - allows for more reliable transitions from grid connected to islanded
 - Grid Forming Inverters are still new to utilities; collaborate on specifications, system design and tuning.
- **Communications and Control Standards for Energy Storage and Microgrids**
 - IEEE 1815.2 - MESA - Modular Energy Storage Architecture

Collaborations and Learning Opportunities

- MESA Alliance Board Member
- UW – Analytics and Reports
- PNNL/ DOE – Analytics, Vehicle-to-Grid (V2G) and Flow Battery testing
- Univ of Texas, PNNL, WSU – GridAmerica - Grid Forming Inverters
- Mitsubishi Electric & Nissan – Vehicle-to-Grid (V2G) integration
- Bonneville Power Association (BPA) – solar smoothing pilot
- Washington Clean Energy Test Beds – solar panel testing
- Other utilities – Avista, Opalco, SCL, PSE, Austin Energy, SMUD, Duke, SRP, etc.

What are the additional benefits?

- **Learning**
 - Design
 - Cost
 - Permitting
 - Construction
 - Operations and Maintenance
 - Challenges
 - System protection and interconnection
- **Better able to support our customers who want to do the same**
- **Collaboration with other PUD departments, utilities and organizations**

Clean Energy Center

Test Load for the
microgrid

Demonstration and
Learning Facility
for:

- K-12 Schools
- Universities
- Other Utilities
- Public Agencies
- Vendors
- etc



The Future of Energy Storage in the Northwest

- Storage is uniquely positioned to take advantage of a changing energy and policy landscape in the Western United States.
- Storage is a capacity resource, and the Northwest has a capacity need.
- Storage is a resource that can provide resource portfolio and distribution system benefits when placed on the grid.
 - In some scenarios, storage can help mitigate or resolve distribution system issues as an alternative or complement to traditional infrastructure (Non-Wires Alternative Analysis)
 - Under such a scenario, storage may provide distribution system benefits, *and* resource portfolio benefits



The Future

- Future of Energy at PUD with new BPA contract
- Creating value with DERs

What drives the future of the District?

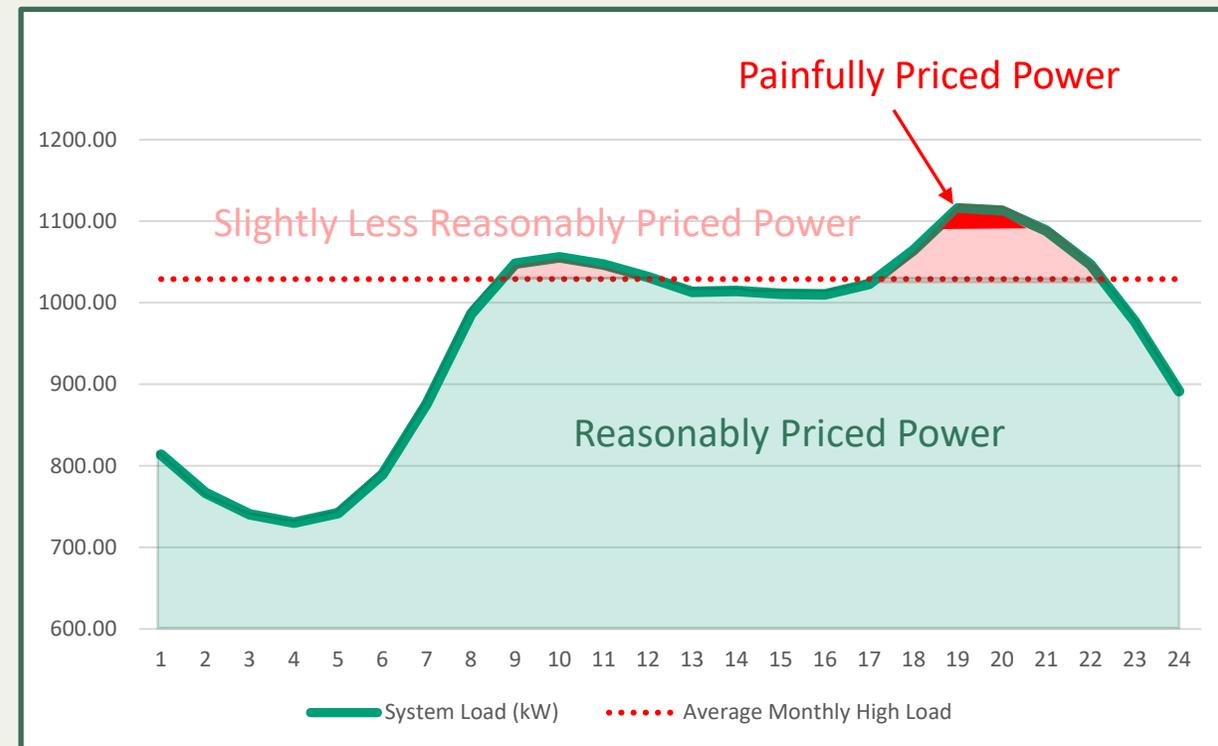
- WA Law
 - I-937: Energy Independence Act – Nov 2006
 - 15% of electricity from renewables other than hydro by 2020, primarily wind and solar
 - Clean Energy Transformation Act – May 2019
 - 100% carbon free by 2045

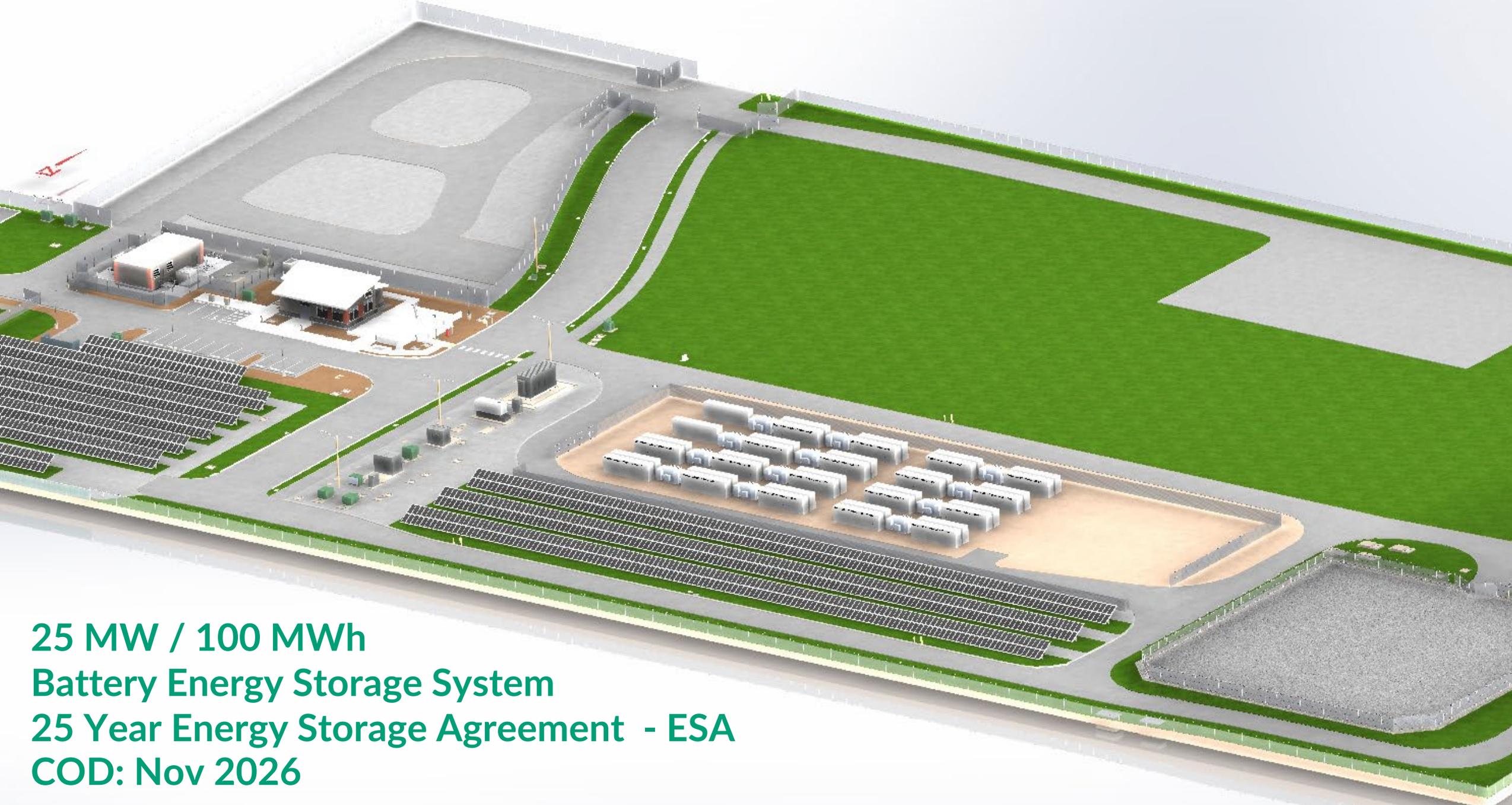
- PNW load growth due to:
 - Population increasing
 - Electrification of buildings
 - Electrification of vehicles (WA Clean Car Act – 2035)
 - Data centers – regional

- PNW needs capacity (resource adequacy) – Megawatts (MW)
 - Previously we would get this from gas-fired peaker plants
 - Now we use energy storage (batteries or pumped hydro)

Today's Energy at the District

- **Majority of the District's power is purchased from BPA**
 - Base hydro provides enough power to cover *most* of the District's load
- **Peak demand periods require additional resources**
 - Expensive \$/kWh
 - Extend the need for gas peaker plants
 - Competition is increasing
- **Load Growth & Supply Challenges**
 - Electrification & population are increasing loads
 - Traditional generation sources are not being built as fast as needed





25 MW / 100 MWh
Battery Energy Storage System
25 Year Energy Storage Agreement - ESA
COD: Nov 2026



The Challenges

Permitting, siting, safety and
life cycle



Siting and land use

- Zoning codes
- Space requirements
- Site layout – proximity to structures
- Permits – special use, conditional use, etc.



Battery Challenges



Sourcing materials



Siting and land use



Fire and chemical safety



Recycling and end of life



Sourcing materials

- Lithium-ion batteries:
NMC vs. LFP
- Ethically sourcing methods
- Mostly non-U.S.-based sources:
 - Lithium: China, Argentina, Chile
 - Phosphate: China, Morocco, Peru, Canada

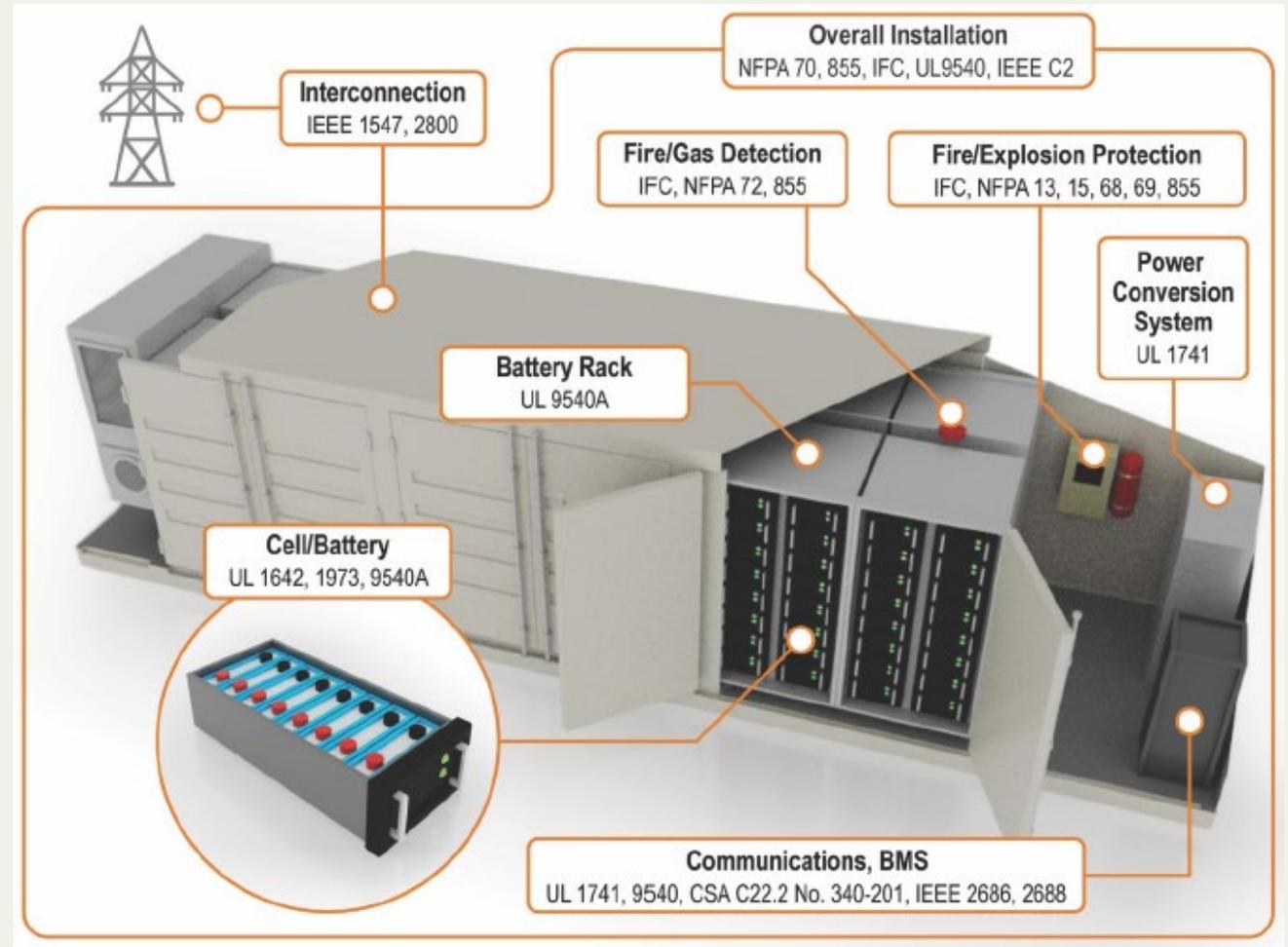




Fire and chemical safety

Codes and standards for battery systems

- International Fire Code (IFC)
- National Fire Protection Association (NFPA)
- National Electric Code (NEC)
- UL Listed components





Recycling and end of life



BESS recycling involves extracting component materials (Li, Co, Ni, Mn, other metals)



An evolving industry: U.S. Department of Energy's (DOE) working toward battery end-of-life guidance in 2024



Recycling and disposal may be less risky than re-use due to liability in hazardous waste handling



The Evolution of Electricity



Questions?

