



AVEVA WORLD



Sustainable Synergy - Harnessing new technology for reliability



APS AT A GLANCE

Since 1886, Arizona's largest and longest-serving utility

- 34,646 square mile service territory
 - 11 of 15 counties
 - 1.4 million customer accounts (89% residential)
 - Approximately 45% of Phoenix
- ~6,000 employees
- Peak demand ~8,200 megawatts
- Investor-owned (PNW)



CLEAN ENERGY COMMITMENT



100% clean, carbon-free electricity
to customers by 2050



2030 target; 65% clean energy



2031 retire coal-fired generation



Five (5) GW of IBR's Operational What's Next?

Utility-scale battery energy storage systems (BESS), solar and wind Facilities are becoming an integral part of modern power grids, enabling better grid stability, and reliability.

- BESS Industry is experiencing growing pains and systems are under performing

Several key topics are driving innovation and investment in this sector. Specifically, for utility-scale BESS:

- Performance Management
 - BMS/Controls Systems
 - Factory cell mortality issues/Construction/Integration
 - Ancillary Services
 - Commissioning and Site Acceptance
 - NERC IBR
 - Performance Management



Battery Management Systems (BMS) Integration

- Current State:
 - Advances in Battery Management Systems (BMS) are improving the safety, efficiency, and lifespan of batteries
 - Integration of resources into
 - Owner requirements
 - Market Requirements
 - Utility/Off-taker Requirements
 - Cell / Warranty Requirements
 - Jurisdictional Safety Requirements
- Future State:
 - AI and machine learning for real-time optimization of battery charge/discharge cycles
 - Predictive maintenance.
 - Enhance forecasting of battery performance and manage fleet-level storage systems.





Factory cell mortality/Construction/Integration & Deployment

- Cells produced in Factories less than two (2) years old (newer if in US)
- Tariffs
 - Workforce development
 - Construction of US based Facilities
 - Lead times
 - Market Demand
- On-site Construction/Integration
 - Market demand
 - Mature workforce
 - Quality control
 - Delays



How to optimize, analyze, prioritize, root cause, monitor, corrective action issues?



Ancillary Services

- **Grid stability** requires balancing supply and demand in real-time, extremely challenging with the increasing reliance on intermittent renewable energy sources
- Utility-scale BESS can provide **ancillary services** such as **frequency regulation**, **voltage control**, and **spinning reserve**. **However**, constant cycling of BESS creates an imbalance of the cells, cells begin to heat leading to potential thermal runaway, lifecycle limitations, cell life degradation
- Stacking functions: BESS can provide additional revenue streams, helping utilities and independent system operators manage the power grid more efficiently.
- **To support Ancillary services, the ability to have reliable, real-time data and analytics are a necessity**





Commissioning and Site Acceptance

All Systems (Market, outage management, Market interface, EMS and Trans Ops) must be live for first day of test energy (push/pull from grid)

Monitoring and data collection, how?

AVEVA PI System

Parameters monitored

Throughput / Cycles

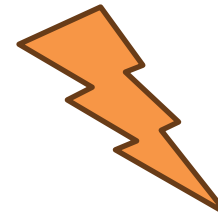
Round Trip Efficiency

State of Charge

Interconnection POI

Settlements

- Payments
- Market settlements



Design Smart from the Start



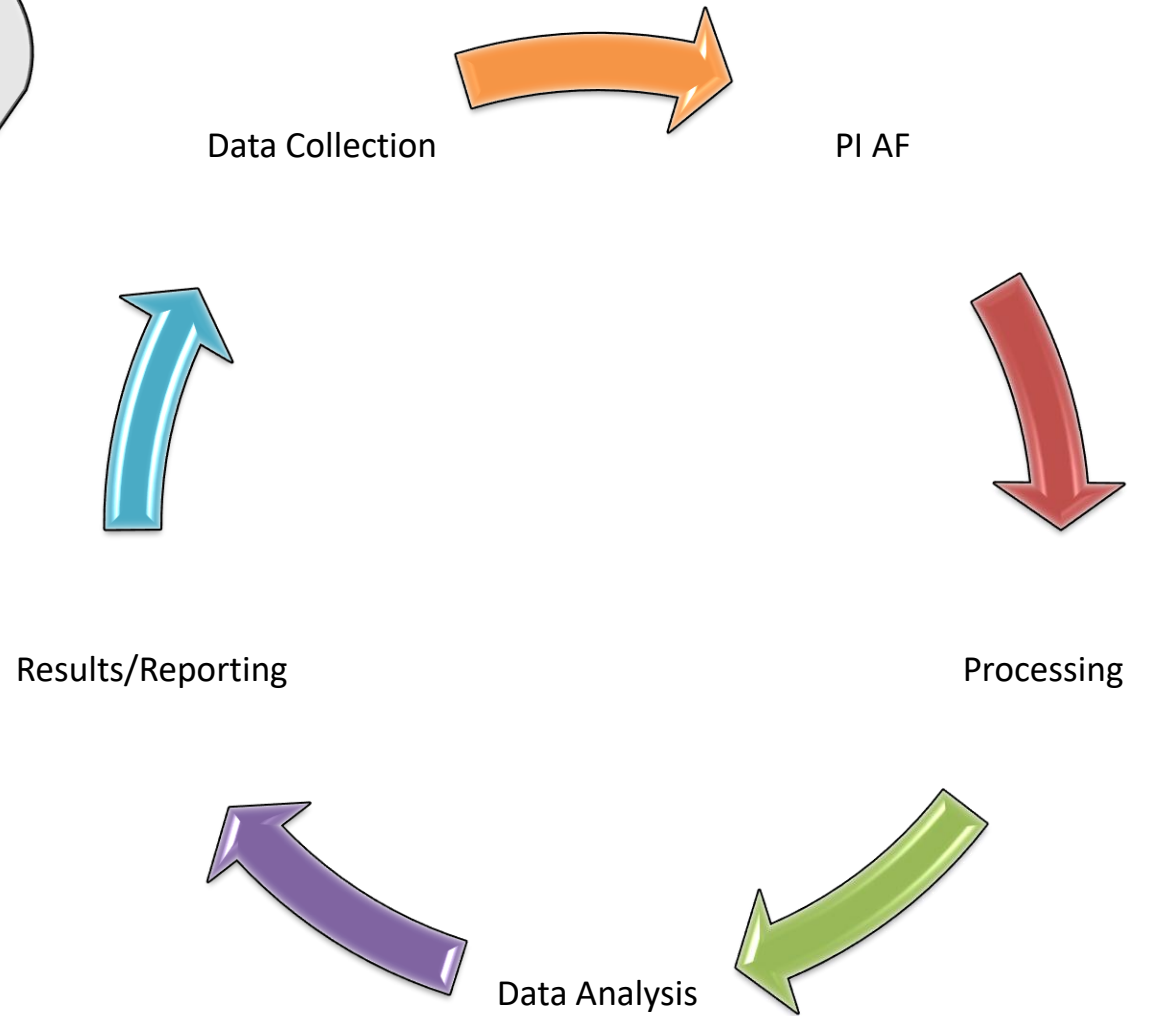
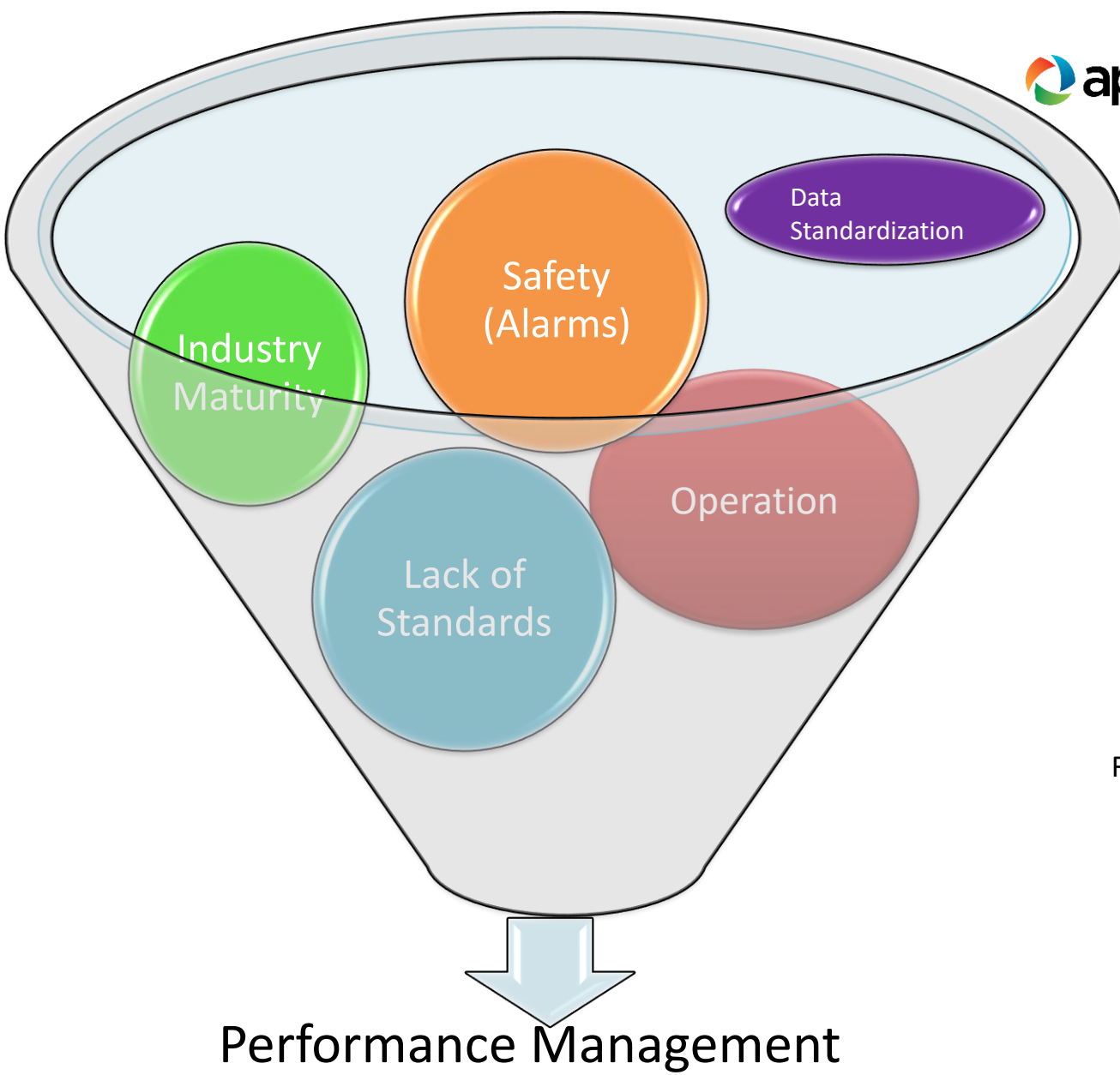


Standard for Inverter Based Resources

- **NERC IBR Rules**

- New compliance obligations for Inverter-Based Resources (IBRs) with a capacity of 20 MW or more
- Generation operators and owners of solar, wind, or battery storage facilities, will see changes:
 - Increased regulatory oversight
 - Added operational complexity
- Resulting in the potential for **significant penalties**
- Develop and implement effective compliance programs tailored to IBRs:
 - Modeling
 - Documentation
 - Reporting
 - Requirements are in development, and unreleased by Transmission Operators (TOPs) and Planning Coordinators (PCs)
- Identify and mitigate challenges specific to IBRs, such as stability, frequency response, and coordination with traditional generation resources, to enhance grid reliability
- What tools and strategies for ongoing monitoring, data submission, and reporting to meet NERC's compliance and audit requirements for IBR entities?







SUSTAINABLE SYNERGY

Challenge

- Realization of optimal asset performance for reliability

Solution

- Enhanced performance management and optimization of BESS, addressing growing pains and underperformance issues within the technology
- Improved data collection and monitoring using the AVEVA PI System, facilitating better resource integration and operational efficiency

Results

- Ongoing efforts to standardize industry practices and address discrepancies in data reporting and resource management
- These results reflect APS's commitment to advancing renewable and energy storage technology and optimizing grid reliability and performance

