Alliant Energy Long Duration Storage

Thermal Mechanical Chemical Energy Storage Conference – July 2025

Corporate Introduction

Alliant Energy: At a Glance

Our purpose: Serve customers and build stronger communities

>95% earnings From regulated operations

1 million electric customers 430,000 gas customers

~3,000 dedicated employees

$14.2 billion 13-month average 2024 rate base

4th largest regulated wind owner-operator

Top 5 largest regulated solar owner-operator

32% of 2024 year-end rate base comprised from regulated owned renewables

~44% of energy from renewable resources in 2024

Emissions Reduction Goals

- **By 2030:**
  - Reduce greenhouse gas emissions from our utility operations by 50% from 2005 levels.
  - Reduce our electric utility water supply by 75% from 2005 levels.
  - Electrify 100% of our company-owned light-duty fleet vehicles.
- **By 2040:**
  - Eliminate all coal from our generation fleet.
- **By 2050:**
  - Aspire to achieve net-zero greenhouse gas emissions from our utility operations.

Generation Expansion

- 1200 MW of Wind Generation
  - 750 MW expected in service by 2028
- 1500 MW gas expected by 2028
- 800 MW of Battery Energy Storage
  - All Expected by 2027

Resource Planning

Future scenario themes

Continuing Industry Change ("CIC")

- Today's economic, market, and technology trends continue

Market Stagnation ("MS")

- Low economic growth results in flat load growth environment and relieves environmental regulatory pressure

Advanced Customer Technology ("ACT")

- Increased adoption and perforr[...] simulate duck-curve conditions

New Regulation ("NR")

- New environmental regulations [...] prices higher

Aggressive Decarbonization ("AD")

- Regulatory pressure manifests as a cap on CO_2 emissions; increased economy-wide decarbonization drives electrification demand. Includes EPA greenhouse gas rules

High Load Growth

- Today's economic and technology trends, combined with a future of onshoring, hydrogen production, high data center growth, etc.

Like other utilities, Alliant Energy considers various socio-economic "futures" as part of its resource planning process

Alliant Energy

Candidate portfolio alternatives

Resource Option Technology	First Available Year	Capacity Factor	Storage Duration
Wind Re-Power	2024/2026	37%	-
New Wind	2024	45%	-
New Solar	2024	24%	-
New Li-Ion Battery	2027	-	4hr
New Flow Battery	2027	-	10hr
New Iron Air Battery	2030	-	72hr
Thermal Storage	2027	-	24hr
Natural Gas Peaking***	2026	-	-
Hydrogen-enabled Natural Gas Peaking	2027	-	-
CCS Retrofit on Ottumwa	2035	-	-
CCS Retrofit on Emery	2039	-	-
New Gas CC w/ CCS	2035	-	-
Small modular reactor	2035	-	-

Alliant Energy is already considering long duration storage as part of its long-term expansion planning analysis

SAMPLE PARAMETERS – INDICATIVE CONCEPTS ONLY

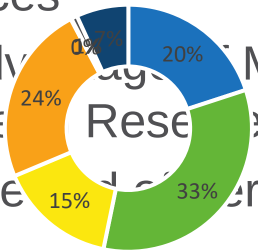
Energy Storage key-aways from resource planning analyses

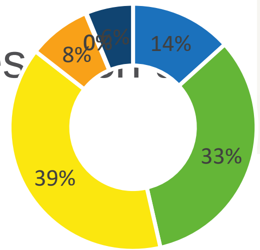
- Storage of varying duration is modeled in expansion plans, and analyzed in reliability analyses.
- Four-hour battery storage optimally selected in expansion plans.
- Long duration storage generally not selected in near-term, but may be an option over long-term depending on costs and capability.
- Long duration storage appears key to close the reliability gap for a carbon-free future.
  - May need multi-day storage to address all challenges
  - Mitigates the need for onsite fuel storage or natural gas peaking

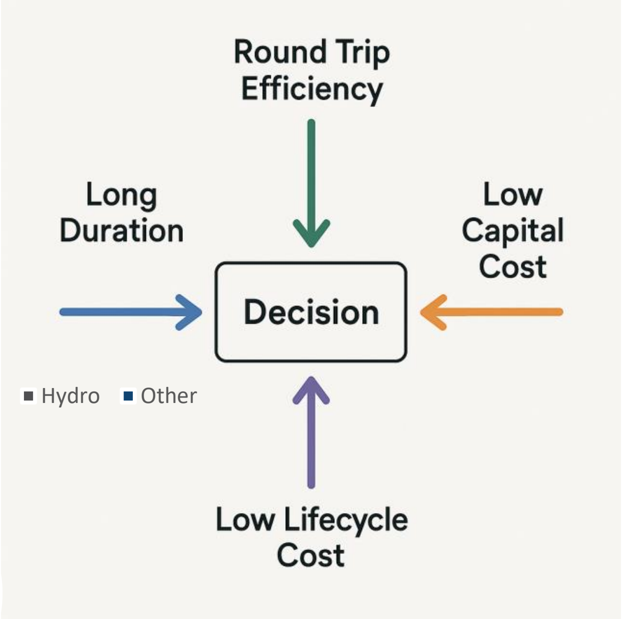
Technology Needs Assessment

Long Duration Energy Storage Needs

- Ability to Leverage Existing Renewable Generation
  - Solar
  - Wind
- Capture renewables during periods of high generation and low demand
- Provide increased stability for transmission system, and avoid restrictions created by Inverter Based Resources
- Take adv… MISO market services … Short Te… Rese…e
- Track Re… …erformance







Where we see opportunity…

Columbia Energy Storage Pilot Project

Technology Selection - Performance

Energy Dome	Lithium Ion
~75% RTE	88% RTE
$500/kWh	$500/kWh
Negligible	>30% Lifetime
30 year	20 year
18 MW (0.1 C)	Scalable (1 C)

- Round Trip Efficiency
- Energy Storage Cost ($/MWh)
- Minimal Degradation
- Long Design Life
- High Power Capacity

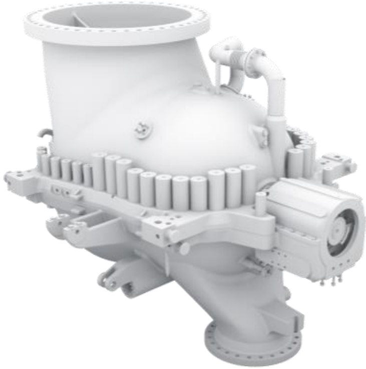
Technology Selection – Established Concept

Standardized design

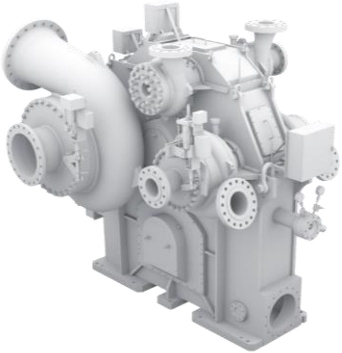
(18 MW/ 180 MWh)

- Scalable to asymmetric charge/discharge rates.
- Storage capacity can be increased with existing turbomachinery

Proven turbomachinery technologies for industrial use



Turboexpander



Integrally Geared Compressor

Columbia Energy Storage

- Land for future expansion
- Reuse of existing 13.8kV switchgear
- Utilizes existing interconnection
- Leverages existing warehouse and personnel expertise
- Electrical Equipment available for four systems[1]

[1]:Full capability available upon plant retirement

QUESTIONS

Backup Slides

Environmental Aspects

- Reuse of closed secondary ash pond and use of overburden stockpile for fill
- High recyclability rate
- Minimal Foundation Requirements
- Ease of site restoration

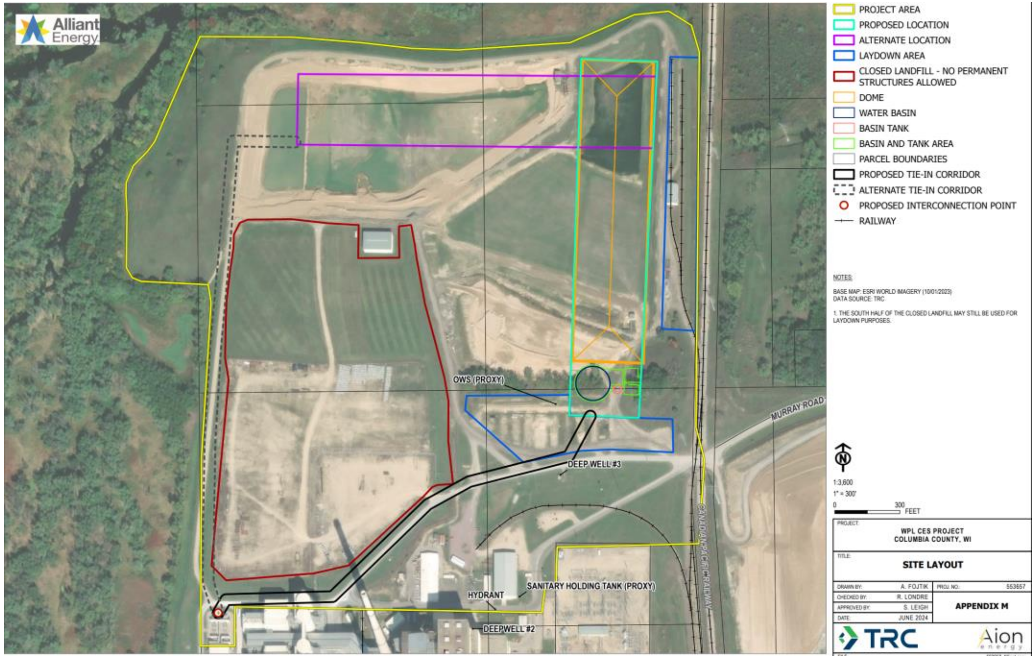
Resource planning study goals

Customer Value	• *Evaluate customer affordability and rate stability* • *Evaluate long term alternatives for existing resources to maximize value for customers*
Reliability	• *Enhance diversity and flexibility to maintain reliability and cost effectively meet changing resource adequacy requirements, market dynamics, and customer needs* • *Ensure availability of resources to manage challenging operational conditions during all hours of the year*
Flexibility	• *Increase overall seasonal portfolio capability to manage uncertainty and volatility in capacity markets* • *Create optionality to support economic development* • *Developing a portfolio that provides required operational flexibility as the MISO market evolves*
Sustainability	• *Create a balanced and diverse portfolio to support carbon reduction goals and continued investment in renewables* • *Incorporate current point of view on long duration storage, advanced and modular nuclear, emerging technology, and alternative capacity solutions*

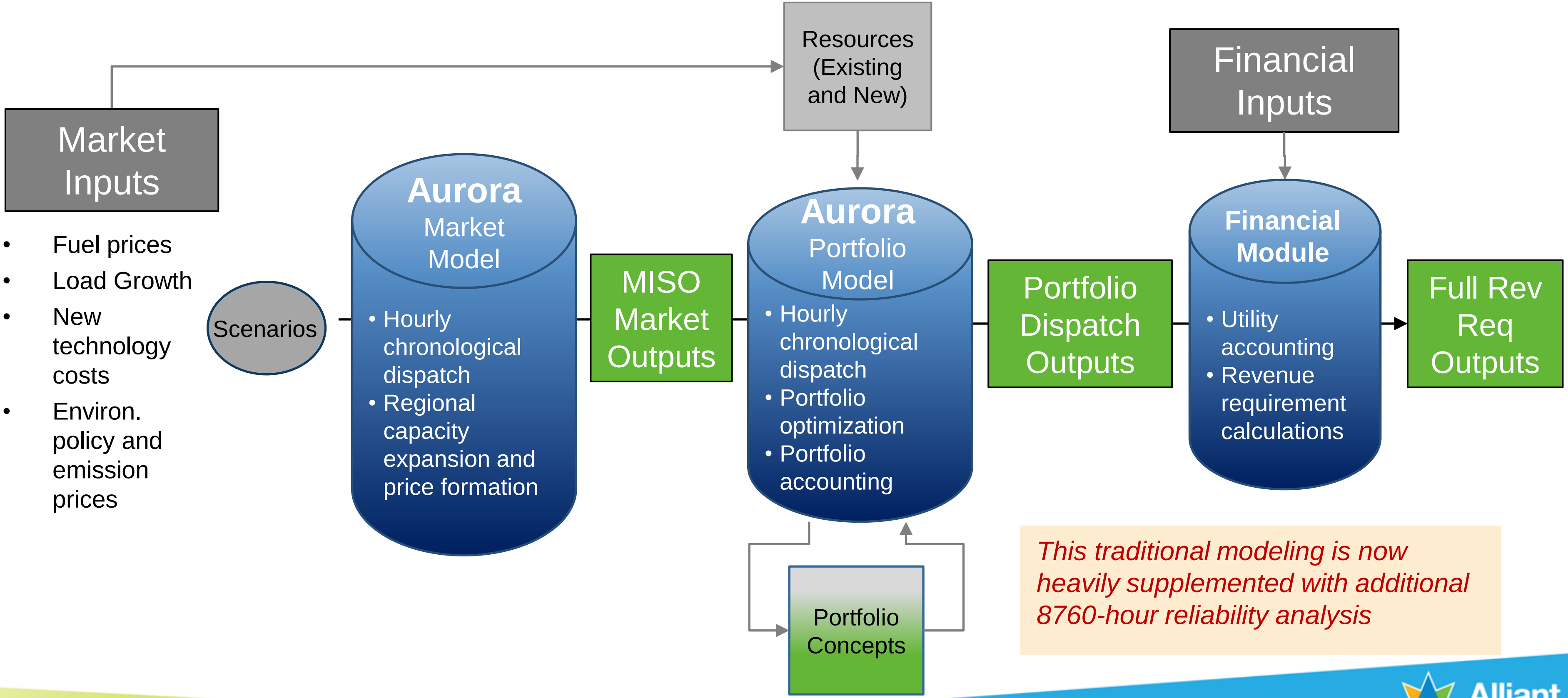
Alliant Energy's resource planning approach has significantly evolved to deal with the challenges of the future

Site Layout

- Water basin and power island



Modeling diagram



This traditional modeling is now heavily supplemented with additional 8760-hour reliability analysis

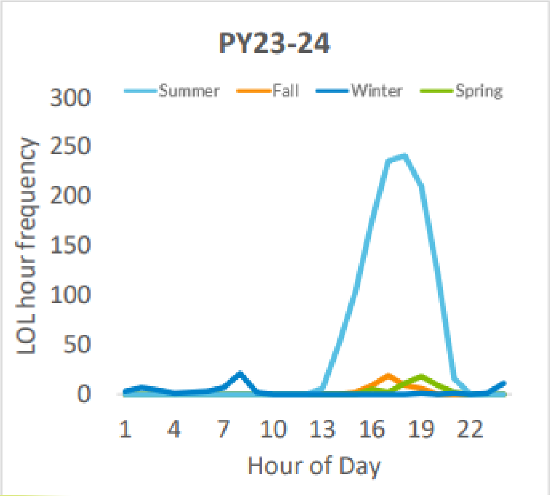
Expanded modeling to consider Loss Of Load risks

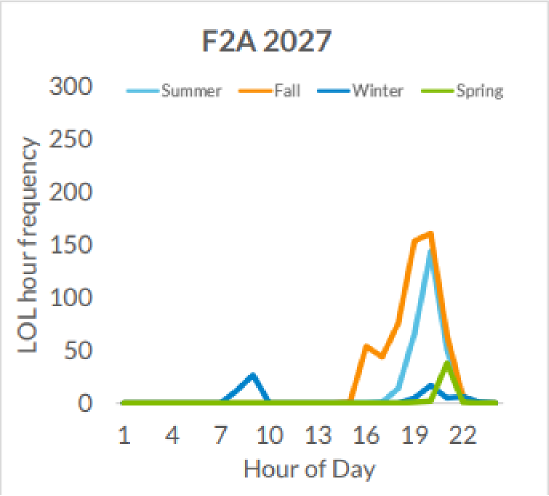
- Accredited capacity and capacity obligations based on resource performance and load during times of tight margin hours

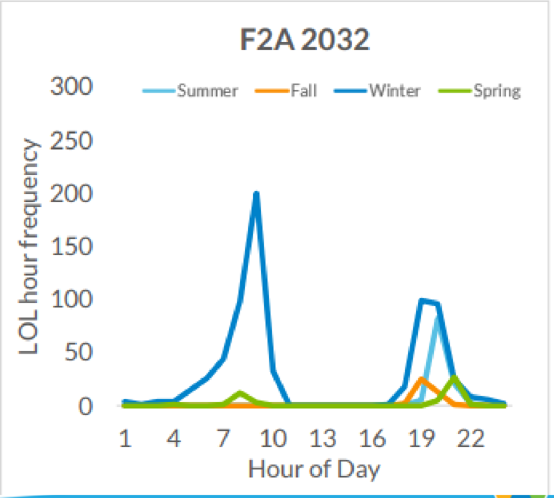
<u>Connection to resource plan:</u>

1. *Portfolio needs to be flexible and robust to satisfy evolving reliability needs and attributes*
2. *Dispatchable resources that compliment renewables in certain high-risk hours are needed to maintain reliability, particularly as decarbonization advances*

LOL = Loss of Load potential







Reliability analysis probabilistic modeling process

Test "islanded" portfolios under multiple weather years to determine individual portfolio reliability and reliance on MISO market (which may simultaneously be at risk)

Data Analysis and Processing

- Historical data gathering for hourly loads and weather
- Data analysis and correlation review
- Assess and adjust for long-term trends as needed (e.g., climate change, economic factors, etc.)

Model Training

- Stochastic processes and time series models - continuous
- Analysis of day types (e.g., based on categories of Clearness Index) – discrete
- Outage models – estimate mean time between failures and mean time for repairs
- Model testing and calibration

Simulation

- Simulate hourly loads, solar and wind generation based on stochastic processes
- For solar and wind, simulation to obtain categories of days/hours (discrete)
- Simulate hourly on/off status for thermal units

Single future year simulation (2030)

Outputs

- Assess alternative portfolio performance
  - Simulated net loads calculated by subtracting renewable generation from load
  - Compute adequacy and flexibility metrics
  - Identify risks

Reliability analysis and Dashboard results

- Evaluate candidate portfolios across the range of simulations for load, renewable output, and outages
- Assess key reliability results for dashboard (frequency, magnitude, and duration of outage/market dependence events plus ramping needs and net load)

	Net Load	Flexibility		Reliability and Energy Adequacy					
Portfolio 1	Summer Peak Net Load (P90)	Max Ramping Capacity (ICAP)	Expected Days w/ 5-Min Ramp Shortage	Resource Diversity	Portfolio Shortfall Dependence	LOLE events	Loss of Load Events	Avg LOLH (Loss of Load Hours)	EUE (Expected Unserved Energy)
Year Ref.	*2030*	*2030*	*2030*	*2030*	*2030*	*2030*	*2030*	*2030*	*2030*
Units	*MW*	*MW*	*Days/Yr*	*%*	*%*	*Days/Yr*	*Events/Yr*	*Hrs*	*MWh*
Portfolio 1									
Portfolio 2									
Etc.									

SAMPLE – INDICATIVE CONCEPTS ONLY

Compare reliability of portfolios with a Dashboard of results – consider this with portfolio costs