ABOUT NARUC

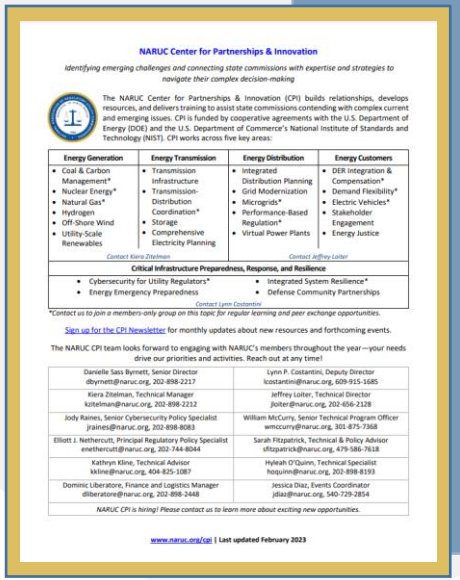
- The National Association of Regulatory Utility Commissioners (NARUC) is a non-profit organization founded in 1889.
- Our Members are the state utility regulatory Commissioners in all 50 states & the territories. FERC & FCC Commissioners are also members. NARUC has Associate Members in over 20 other countries.
- NARUC member agencies regulate electricity, natural gas, telecommunications, and water utilities.

THE NARUC CENTER FOR PARTNERSHIPS & INNOVATION

Background & Focus

- NARUC staff dedicated to providing technical assistance to members.
- CPI identifies emerging challenges and connects state commissions with expertise and strategies to inform their decision making.
- CPI builds relationships, develops resources, and delivers trainings.
- All CPI support is federally funded via cooperative agreements with DOE and NIST.

Newly updated CPI fact sheet with recent publications, upcoming events, new member working groups located under Quick Links at: www.naruc.org/cpi



NARUC Center for Partnerships & Innovation

Identifying emerging challenges and connecting state commissions with expertise and strategies to navigate their complex decision-making

The NARUC Center for Partnerships & Innovation (CPI) builds relationships, develops resources, and delivers training to assist state commissions contending with complex current and emerging issues. CPI is funded by cooperative agreements with the U.S. Department of Energy (DOE) and the U.S. Department of Commerce's National Institute of Standards and Technology (NIST). CPI works across five key areas:

Energy Generation	Energy Transmission	Energy Distribution	Energy Customers
• Coal & Carbon Management* • Nuclear Energy* • Natural Gas* • Hydrogen • Off-Shore Wind • Utility-Scale Renewables	• Transmission Infrastructure • Transmission-Distribution Coordination* • Storage • Comprehensive Electricity Planning	• Integrated Distribution Planning • Grid Modernization • Microgrids* • Performance-Based Regulation* • Virtual Power Plants	• DER Integration & Compensation* • Demand Flexibility* • Electric Vehicles* • Stakeholder Engagement • Energy Justice
Contact Kiera Ztelman		*Contact Jeffrey Loiter*	

Critical Infrastructure Preparedness, Response, and Resilience

- Cybersecurity for Utility Regulators*
- Energy Emergency Preparedness
- Integrated System Resilience*
- Defense Community Partnerships

Contact Lynn Costantini

**Contact us to join a members-only group on this topic for regular learning and peer exchange opportunities.*

Sign up for the CPI Newsletter for monthly updates about new resources and forthcoming events.

The NARUC CPI team looks forward to engaging with NARUC's members throughout the year—your needs drive our priorities and activities. Reach out at any time!

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Dominic Liberatore, Finance and Logistics Manager dliberatore@naruc.org, 202-898-2448	Jessica Diaz, Events Coordinator jdiaz@naruc.org, 540-729-2854

NARUC CPI is hiring! Please contact us to learn more about exciting new opportunities.

www.naruc.org/cpi | **Last updated February 2023**

Recent Publications

- Demand Flexibility within a Performance-Based Regulatory Framework (Feb 2023)
- State Energy Justice Roundtable Series: Customer Affordability and Arrearages; Participation in Decision Making; Energy Justice Metrics (Feb 2023)
- Mini Guide on PUCs and the Investment Community (Feb 2023)
- Energy Resilience Reference Guide: Chapters 1 & 2 (Jan & Feb 2023)
- Potential State Regulatory Pathways to Facilitate Low-Carbon Fuels (Dec 2022)
- Digitalization in Electric Power Systems and Regulation: A Primer (Dec 2022)
- Interoperability for Electric Vehicle Charging: A Case Study (Dec 2022)
- Electric Vehicle Interoperability: Considerations for Utility Regulators (Nov 2022)
- Models for Incorporating Equity in Transportation Electrification (Nov 2022)
- Mini Guide on Transportation Electrification (Nov 2022)
- Grid Data Sharing: Brief Summary of Current State Practices (Nov 2022)
- Regulator's Financial Toolbox Briefs: Community Solar for LMI Customers; Electrification; ADMS/DERMS (Oct 2022)
- Defense Energy Resilience Resources Guide & FAQ for Commissioners (Oct 2022)
- Workforce Development Toolbox: Recruitment Templates and Social Media Engagement Materials (Sept 2022)

Forthcoming Publications

- Black Sky Playbook
- Energy Resilience Reference Guide Chapter 3: Climate Resilience
- State Microgrid Policy, Programmatic, and Regulatory Framework
- Renewable Energy Microgrids
- Considerations of Advanced Nuclear in Resource Planning

Upcoming Virtual Learning Opportunities

- **Modern DER Capabilities and Deployment. March 8:** Next in the virtual interconnection workshop series, NREL will address PUC questions on DER technical capabilities, deployment concerns, and benefits. *Contact Jeff*
- **Resilience for Regulators Webinar Series. March 9:** Climate Informed Mitigation Strategies. Find past presentations on critical infrastructure resilience, climate resilience, defense energy resilience, and more. *Contact William*
- **Monthly Innovation Webinars. March 16:** Advances in Resource Adequacy. Register | past recordings. *Contact Jessica*
- **On-Demand, Video-Based Learning Modules.** Dozens of training videos in English and Spanish on electricity system planning, distribution systems and planning, smart grid and EV interoperability. *Contact Danielle*

Upcoming In Person Events *Travel stipends available*

- Cybersecurity Training, Indianapolis, IN. **March 22-24:** Experts will provide content on cybersecurity topics through the lens of utility regulators with presentations, engaging activities, and more. (Commissioners and staff) *Contact Lynn*
- Nuclear Energy Partnership Pacific Northwest National Lab Site Visit. **April 25-28:** Tour PNNL and NW nuclear sites. Advanced Nuclear State Collaborative kickoff workshop will also take place. (Commissioners and staff) *Contact Kiera*
- Natural Gas Partnership Site Visit, Savannah, GA. **May 2023:** Tour the Elba Island liquefied natural gas export facility, Port of Savannah compressed natural gas fueling station, and more. (Commissioners only) *Contact Kiera*
- More Info Available Soon: **Energy Justice Midwest Regional Workshop (early May); Grid Data Sharing Collaborative Demonstration Workshop (mid-May** in Washington, DC); **Resilience Planning Regional Workshops** *Contact Danielle*

Join a Member Working Group! *For Commissioners and Commission Staff*

- **Integrated Distribution System Planning.** Register for presentations by subject matter experts and commissions followed by questions and facilitated discussions among members. Six sessions; **Feb 27 – Jun 12.** *Contact Jeff*
- **NARUC-NASEO Advanced Nuclear State Collaborative.** Exchange questions, needs, and challenges relating to the planning and deployment of new advanced nuclear generation. *Contact Kiera*
- **NARUC-NASEO Microgrids State Working Group.** Explore capabilities, costs, benefits, and deployment strategies for microgrids with PUCs and State Energy Offices. *Contact Kiera*
- **Electric Vehicles State Working Group.** Learn and discuss regulatory questions around transportation electrification, including charging infrastructure buildout, rate design, equity considerations, V2G, and more. *Contact Danielle*
- **Performance-Based Regulation State Working Group.** Examine approaches to performance-based regulation and alternative ratemaking across states in a collaborative peer group setting. *Contact Elliott*
- **I2X Working Groups.** DOE/National Lab effort for commissions and stakeholders to identify grid interconnection challenges and discuss solutions. *Contact Jeff*
- **Workforce Development Peer Advisory Group.** Supporting recruitment & retention for commissions. *Contact Hyleah*

www.naruc.org/cpi | **Last updated February 2023**

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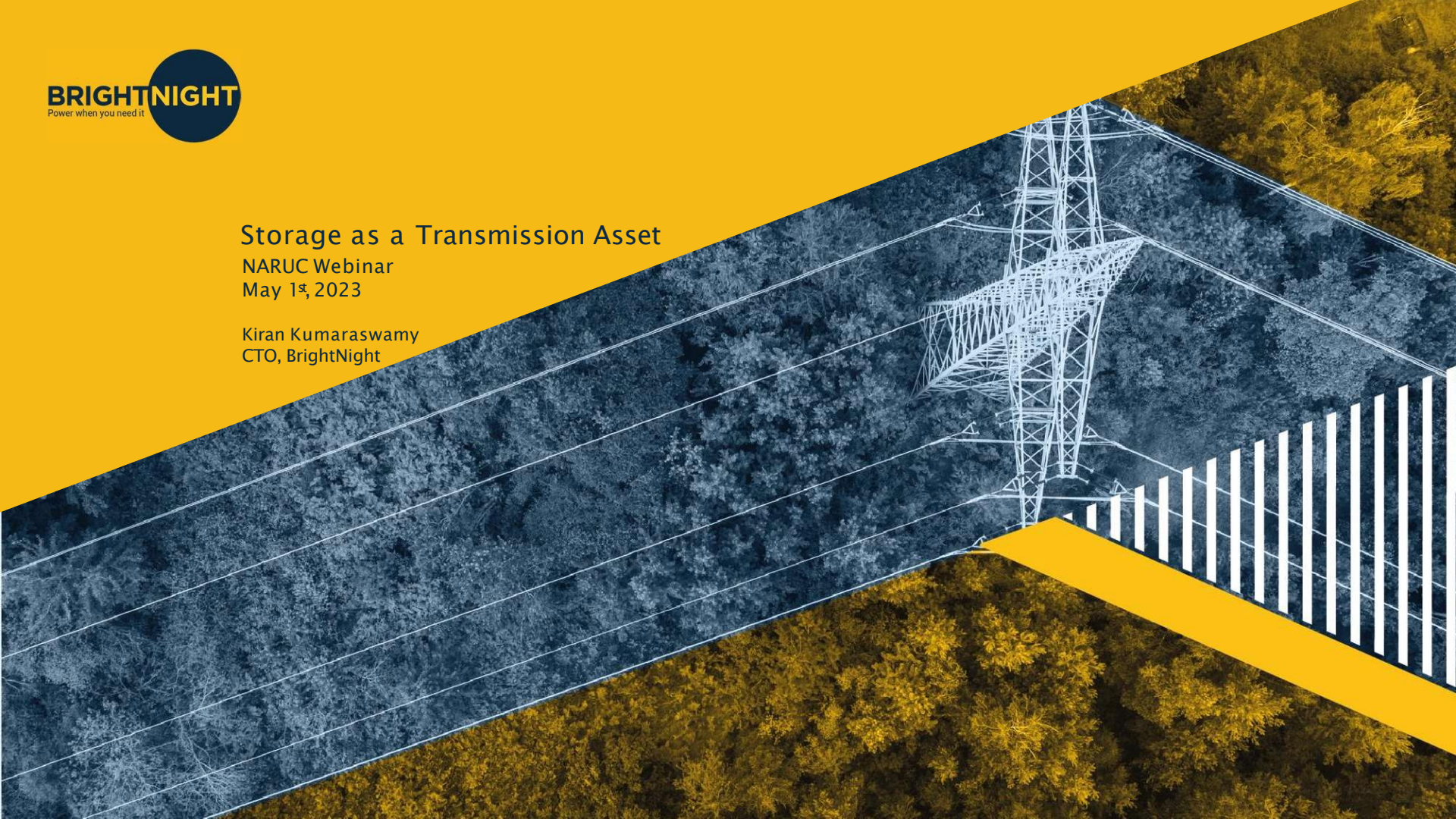
BRIGHTNIGHT
Power when you need it

Storage as a Transmission Asset

NARUC Webinar
May 1st, 2023

Kiran Kumaraswamy
CTO, BrightNight



BrightNight – A Renewable Power Solutions Company

BrightNight is a founder-owned renewable independent power producer (IPP) focused on providing its customers and partners with differentiated solutions with a focus on safety, value, reliability and best-in-class execution

21 GW project portfolio

2 GW project portfolio

Renewable Dispatchable Capacity
Meeting today's power demand and sustainability goals

PowerAlpha
Our proprietary software provides a tailored analysis for customers to uncover the highest value project and to optimize asset management

Customer-centric
We learn about your goals and challenges to design a renewable solution not just a project

Single Point of Contact
Leading you through project design, contracting, development, operation, maintenance, and lifelong optimization

Both on generation and transmission we have the same problem to solve – low utilization, high capital cost assets that can be recovered only on capacity basis

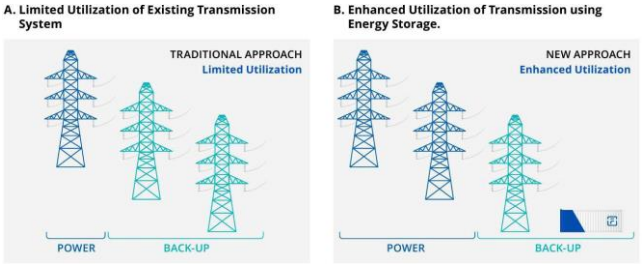
Storage as Peaking Capacity

Battery energy storage as a much better alternative to traditional gas-fired peaking plants – solves capacity issue in gen side more effectively.

Source: Wartsila, S&P

Storage as Transmission Enhancement

Suboptimal utilization of high capital cost transmission cost can be remedied by use of battery energy storage. Helps "right size" transmission and utilize more effectively.

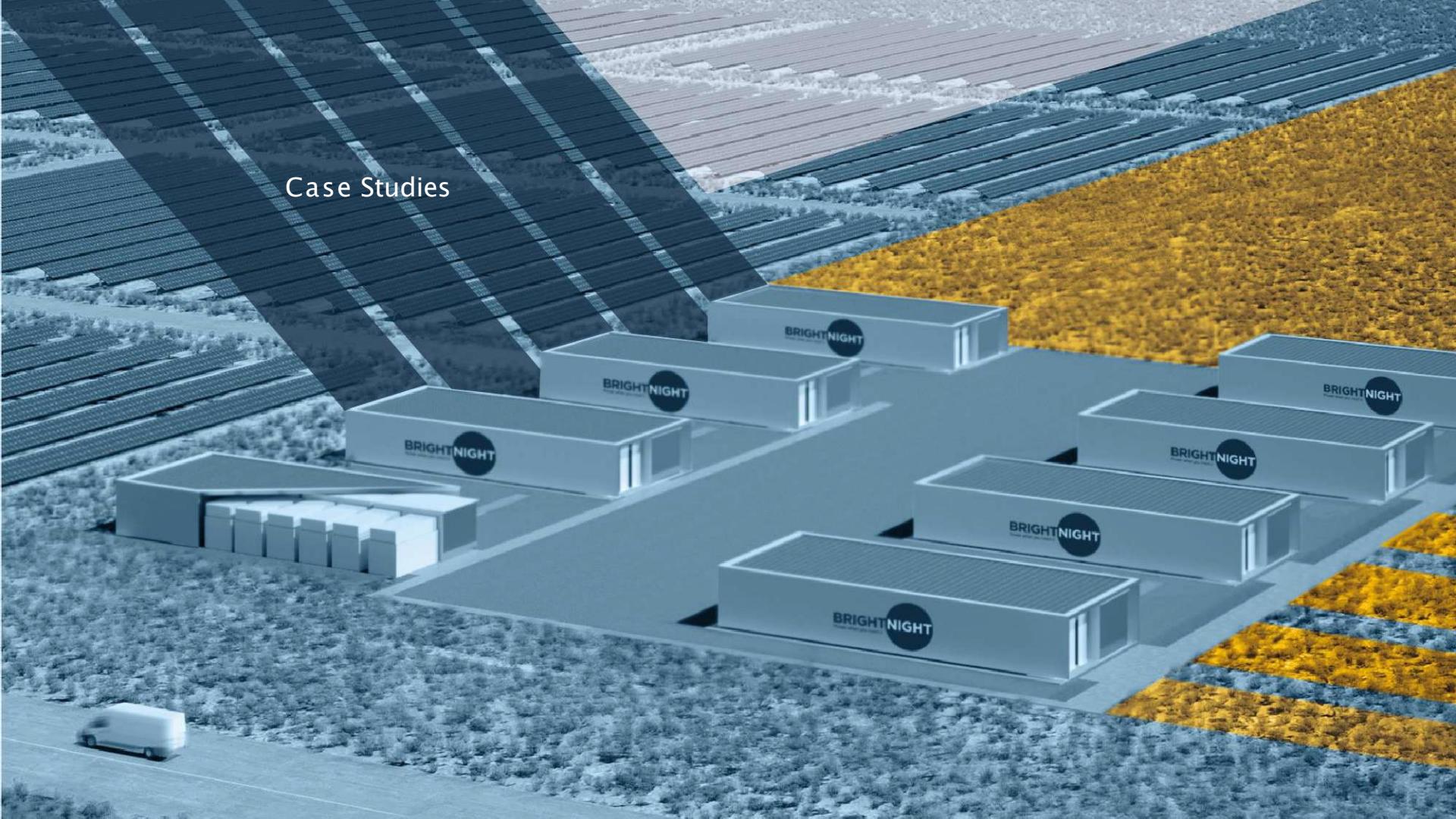


Source: Fluence

Trivia # 1 – How do we measure utilization on gen side?
Hint – CF (Capacity F_____)

Trivia # 2 – How do we measure utilization on transmission side?
Hint – ???? (AC system, "*Oh, its complicated*")

Case Studies



Global Case Study #1: Germany's GridBooster program leads the way

Redispatch costs in Germany can be **reduced by about 60% with 4GW of SATA capacity**

- North-South transmission congestion in Germany causes curtailment of renewables in the North and re-dispatch of expensive generation near the load centers in the South.
- In 2021, total redispatch costs in Germany amounted to about **EUR2.3bn** with **5.8TWh of renewables curtailed**.

How **GridBooster** helps?

- **Reactive System Operation** – Utilizing storage to improve the utilization of North-South transmission corridors during normal operation while still meeting (n-1) system security criterion for contingencies

Key Benefits

- Increasing infrastructure utilization while ensuring reliable operation
- Fast response and ability to inject or absorb load from the grid instantaneously
- Deployment within short time frames close to existing transmission substations with manageable footprint
- Substantial reduction of congestion management costs

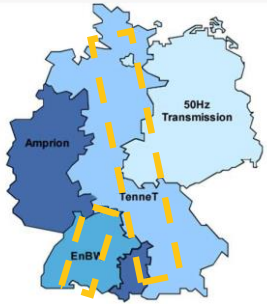
TRANSNET BW

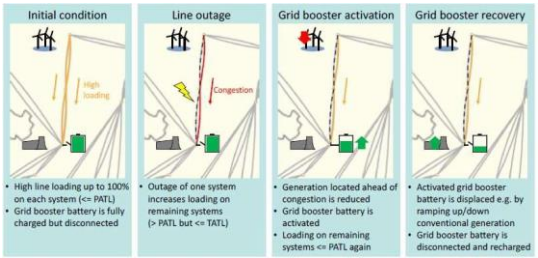
- **Size**: 1x250MW / 1Hr
- **COD**: Q2 2025

TenneT

Size: 2 x 100MW / 1Hr

COD: Q3 2025





Reactive system operation and the role of batteries

Source: Consentec, Fluence

Global Case Study #2: In New York, SATA deployment at 3 locations has enabled more than $150M savings compared with best alternative wires solution

1. At the Shore Rd 345kV substation, SATA enabled **congestion reduction** and increased transmission capacity while keeping cable loading under applicable ratings

Transfer limit (MW)	Summer (MW)	Winter (MW)
Zone I & J to Zone K	965	1077
Zone I & J to Zone K w/ 200MW storage at Shore Rd	1167	1280

2. At the Edic 345kV substation, as an **automatic voltage regulation equipment (AVCE)** to maintain a consistent Central East interface transfer capability.
   - ~300MW curtailment avoided

3. At the Mott Haven 345 kV substation, SATA is deployed to improve New York City Zone J system **reliability and reduce reserve capacity requirement**
   - Improvement in Transmission Security Limit (TSL) of 329.5MW and thus reduce Local Capacity Requirement (LCR)

Location	Battery Size	Estimated SATA Cost [$M]	Estimated Wire Solution Cost [$M]	Local Area Annual Cost Saving [$M]	NYCA-wide Congestion Annual Cost Saving [$M]
1	200MW/200MWh	120	700	9.9*	13.1
2	50MW/50MWh + 1,500MVar reactive power capacity	250	615	51.0**	55.0
3	200MW/200MWh	120	533	30.4***	17.8

* Congestion cost saving for Zone K
** Congestion cost saving for central east interface
*** Zone J LCR saving and congestion cost saving

Source: Storage as Transmission Asset Market Study – Quanta Technology, NY BEST

Key Benefits of New York SATA deployments:

- Cost-effective compared to convention wire solutions
- Shorter development, permitting and construction timeline
- Capacity can be added incrementally with demand growth

Kiran Kumaraswamy
Chief Technology Officer, BrightNight
Kiran.kumaraswamy@brightnightpower.com

Pacific Northwest
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Energy Storage as a Transmission and Dual-Use Asset

May 1, 2023

Jeremy Twitchell

NARUC Innovation Webinar: Storage as a Transmission Asset

U.S. DEPARTMENT OF ENERGY BATTELLE

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

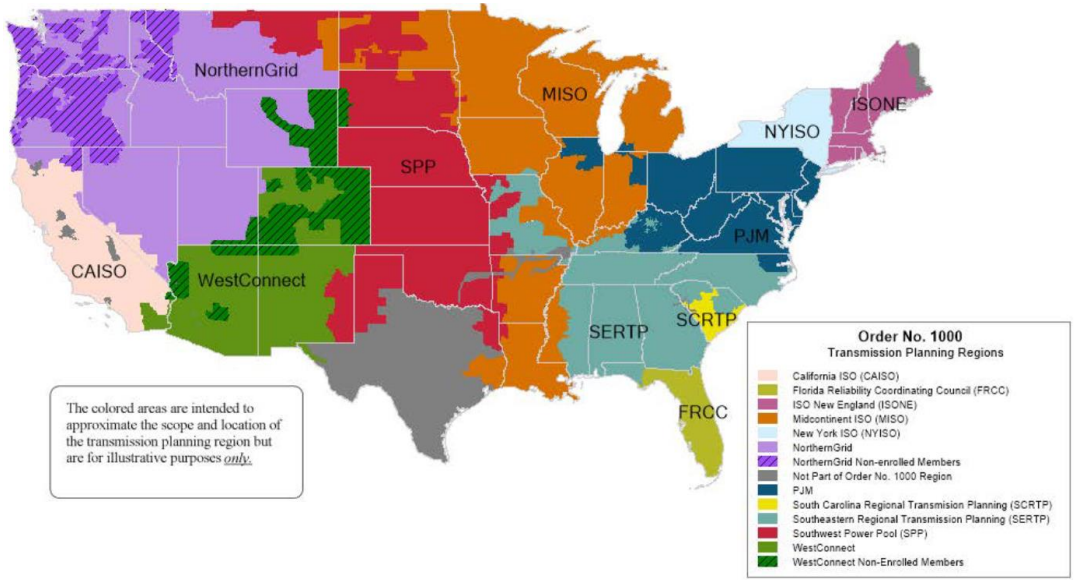
Acknowledgment

The work in this presentation was funded by the U.S. Department of Energy, through the Water Power Technologies Office's HydroWIRES Program, under the direction of Dr. Samuel Bockenhauer.

Our project partners at Argonne National Laboratory, led by Zhi Zhou, have prepared a companion report that presents a techno-economic analysis of a theoretical dual-use pumped storage hydropower asset based on the participation model in this presentation.

Storage as Transmission – Policy Background

- **Energy Policy Act of 2005**
  - Defines energy storage as an “advanced transmission technology,” which “increases the capacity, efficiency, or reliability of an existing or new transmission facility”
- **FERC Order 890 (2007)**
  - Transmission owners must conduct transparent transmission planning processes
- **FERC Order 1000 (2011)**
  - Requires coordinated, regional transmission planning
  - Non-transmission alternatives must be considered
- **FERC Order 784 (2013)**
  - Created Account 351: Energy Storage Equipment—

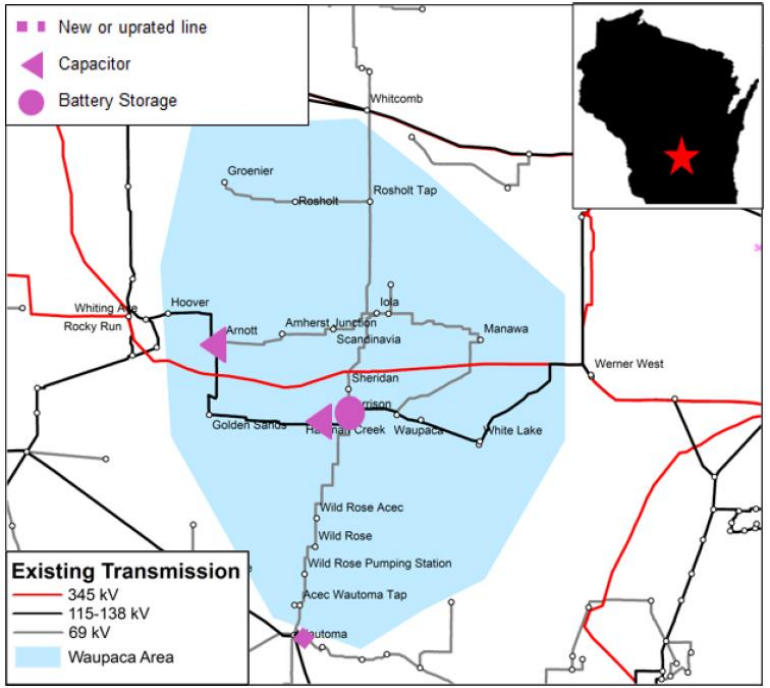


Key Principle: Thermal Limits

- **Because the metals used in transmission lines are not perfect conductors, they heat up as electrical current moves through them**
  - This is what causes line losses
  - As lines heat up, they expand and begin to sag
  - Because of this phenomenon, the operational limits of transmission lines are set as a function of heat
- **Energy storage is a potential alternative for alleviating thermal overloading on transmission lines**
  - By siting storage or generation resources within load centers, less energy needs to be delivered over the transmission system during peak periods when the system is constrained
  - Storage can also be used to protect and support transmission infrastructure by maintaining voltage, managing power flows, and absorbing excess power
  - Where feasible, this approach can extend the life of existing assets and defer or displace the need for new transmission infrastructure
  - Storage may be deployed as a regulated transmission asset or in place of transmission as a competitive generation asset

Storage as Transmission: MISO

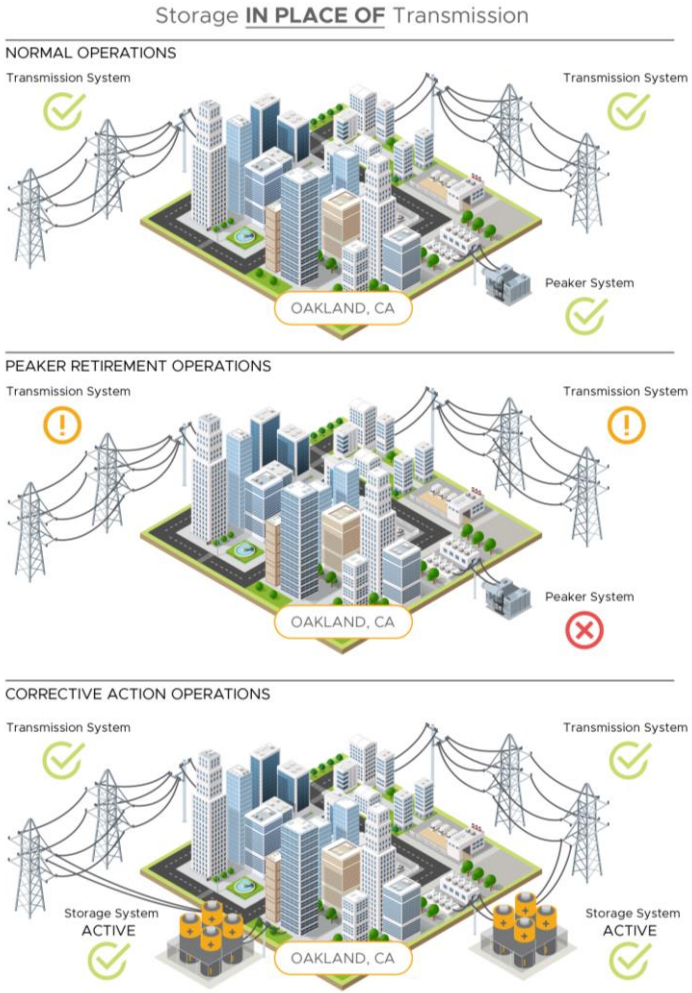
- **The 2019 MISO Transmission Expansion Plan (MTEP) selected energy storage as a transmission asset**
- **Storage as Transmission: Waupaca, WI**
  - Under certain N-1 contingency scenarios (line outages), the Waupaca area would be cut off
  - At $12.2 million over 40 years, a 2.5 MW/5 MWh energy storage system, coupled with line sectionalizing, was selected over a $13.1 million project to install an additional circuit
- **As a transmission asset, the storage system's costs will be recovered through MISO's FERC-approved transmission system rates, and it will not participate in energy markets**



MTEP 2019

Storage in Place of Transmission: Oakland Clean Energy Initiative

- **The Jack London Power Plant was a 165 MW, jet fuel-powered combustion turbine**
  - Identified for retirement in 2017, but local transmission system would exceed thermal limits under N-1 scenarios without it
  - Alternatives: transmission system upgrades, new local generation (up to 45 MW), energy storage
- **CAISO identified a joint proposal from transmission system owner Pacific Gas & Electric and local community choice aggregator East Bay Community Energy to procure energy storage and distributed generation as the least-cost option**
  - PG&E will procure 43.25 MW/173 MWH utility scale storage; EBCE will work with customers to deploy DG and storage
  - $102 million project; next-best alternative was $367 million
  - None of this storage would be a regulated transmission asset; all dispatch and recovery would happen through energy markets and utility programs (net metering and other incentives)



FERC Policy Statement on Dual-Use Storage (2017)

- Policy Statement: Once deployed as a transmission asset, energy storage may also provide market services and generate offsetting revenue that can be shared with customers to reduce system costs.
- A policy statement is a nonbinding document
  - The California Independent System Operator (CAISO) and Midcontinent Independent System Operator (MISO) are the only entities to voluntarily respond to the policy statement, though neither has yet identified a solution

Generic Example of Revenue Sharing Impacts

Year	Transmission Revenue Requirement	Market Revenue Credit	Net Transmission Revenue Requirement
1	($1,250,000)	$50,000	($1,200,000)
2	($1,225,000)	$50,000	($1,175,000)
3	($1,200,000)	$50,000	($1,150,000)
…			
38	($325,000)	$50,000	($275,000)
39	($300,000)	$50,000	($250,000)
40	($275,000)	$50,000	($225,000)
Total	($30,500,000)	$2,000,000	($28,500,000)
Net Present Value	**$10,000,000**		**$9,511,047**

Key Principle: Transmission Utilization

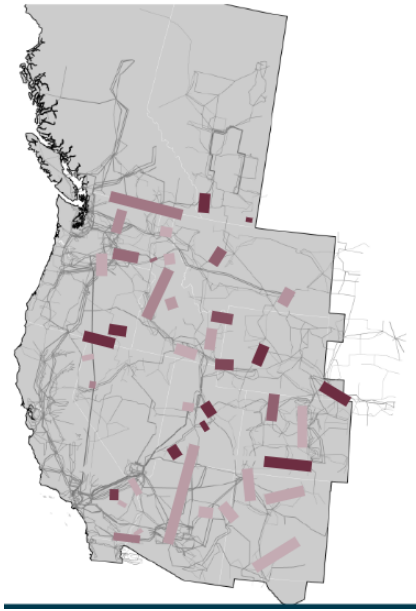
- **Key principle: Even on fully contracted, heavily utilized transmission lines, there is unused capacity *most of the time*.**

- These numbers mean that regionwide, for 93.8 percent of the time in 2018, less than 75 percent of the average transmission line's firm capacity was being used.

- Conversely, the average line exceeded 90 percent of its rated capacity just 1.3 percent of the time.

- Implication: If deployed as transmission, energy storage would likely have significant opportunities to provide other grid services outside of peak periods.

2018 Path Utilization



Season
- All
- Winter
- Spring
- Summer
- Fall

2018 Path Utilization Statistics

Path	U75	U90
Path 1	19.5%	4.1%
Path 3	5.5%	0.7%
Path 4	3.4%	0.3%
Path 5	0.3%	0.0%
Path 6	0.0%	0.0%
Path 8	8.0%	1.2%
Path 14	4.1%	1.6%
Path 16	0.1%	0.1%
Path 17	1.2%	0.1%
Path 18	9.8%	0.0%
Path 19	20.7%	4.0%
Total	**6.2%**	**1.3%**

WECC, 2018 State of the Interconnection, https://www.wecc.org/epubs/StateOfTheInterconnection

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Facilitating Storage's Inclusion in the Transmission Planning Processes

Identifying cost-effective opportunities to use energy storage as a transmission asset consists of two principles:

- Establish clear, transparent processes for the proposal and study of energy storage
  - CAISO: Preferred resources policy creates an informal expectation for planning staff to proactively identify storage alternatives and consider stakeholder proposals
  - MISO: Transmission planning rules describe a clear, formal structure for analyzing storage alternatives
- Prepare a reasonable forecast of future market revenues to quantify the true cost of the asset to transmission customers
  - Over time, market revenue sharing reduces the cost of the asset to customers; forecasting and accounting for those revenues on an upfront basis ensures that the true cost of the asset is reflected in the decision and increases the accuracy of planning outcomes
- State regulators can be influential stakeholders in transmission planning processes
  - While state regulators do not oversee transmission planning in the same manner as other grid functions, they can encourage analysis of transmission alternatives

Market Barriers to Dual-Use Storage

To overcome the barriers between regulated transmission operations and competitive market operations, a dual-use participation process must answer three basic questions:

- **When** will the asset participate in the market?
  - Objective: Allow asset owner to make informed bids into day-ahead markets
- **How** will the asset participate in the market?
  - Objective: Allow for instant, no-fault dispatch and redispatch of dual-use assets
- **Where** will the asset recover its costs?
  - Objective: Create appropriate signals for market participation that balance competing objectives of transmission and market uses

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Thank you

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971-940-7104

PNNL Report (participation framework):
https://www.osti.gov/servlets/purl/1846604

ANL Report (techno-economic analysis):
https://publications.anl.gov/anlpubs/2022/09/177099.pdf

Storage as a Transmission Asset

Gabe Murtaugh
Storage Sector Manger
May 1, 2023

Reminders

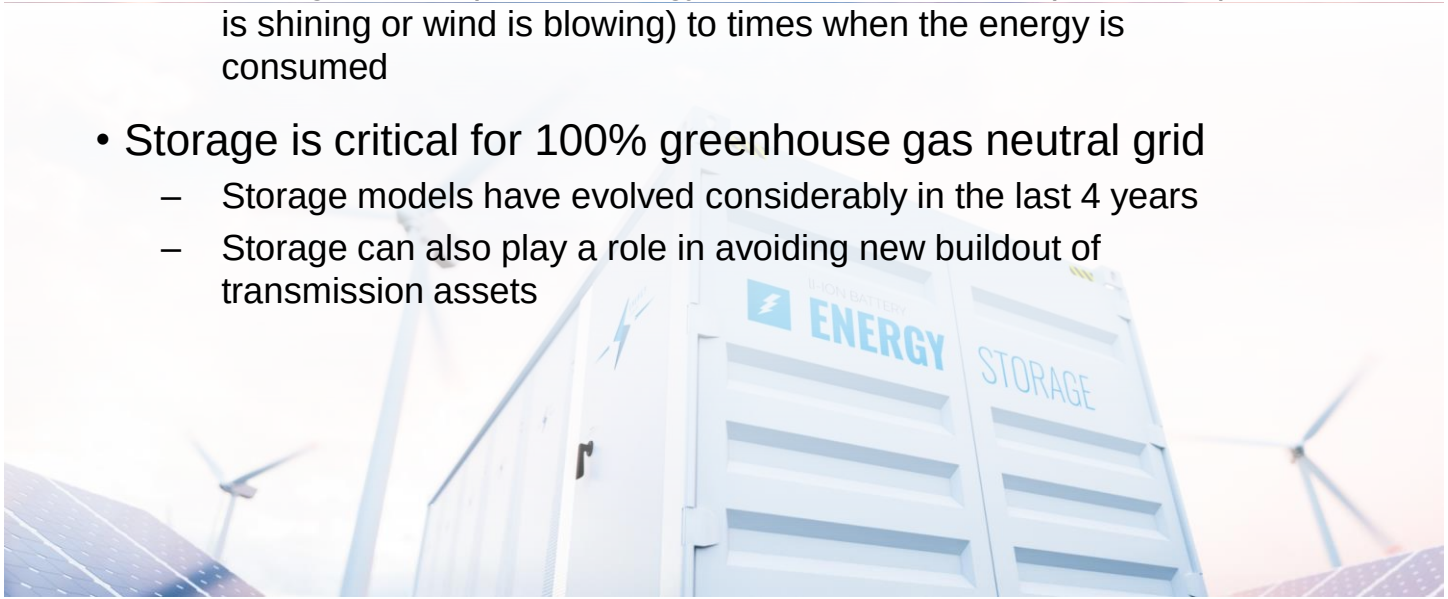
- This call is being recorded for informational and convenience purposes only. Any related transcriptions should not be reprinted without ISO permission.
- If you need technical assistance during the meeting, please send a chat to the event producer.

For Questions:

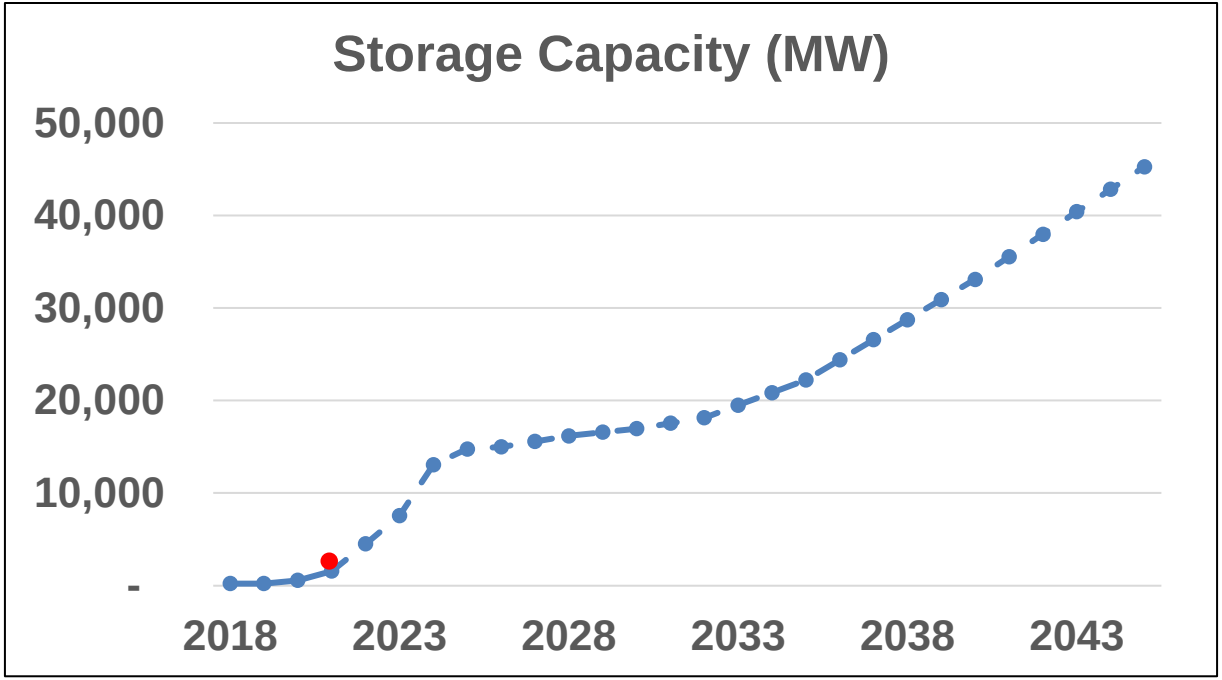
- Please raise your hand using the “raise hand” feature in Zoom, or submit your question through the chat.
- Please state your name and organization when asking your question.

Storage is critical to evolving to a carbon free grid

- Plans for carbon free energy generation come from renewable resources
  - In California, solar will be a predominant energy source
  - Storage can help store energy from times when it is produced (sun is shining or wind is blowing) to times when the energy is consumed
- Storage is critical for 100% greenhouse gas neutral grid
  - Storage models have evolved considerably in the last 4 years
  - Storage can also play a role in avoiding new buildout of transmission assets



California expects a very large buildout of storage to meet net-zero GHG emissions target for the state



Storage resources have already provided value for alternatives to wire solutions in local areas

- California already has 2 projects that were developed in local areas to avoid transmission projects
  - Load growth and electrification drive need for more electric service
  - In local areas batteries can utilize existing transmission infrastructure earlier in the day to charge, when lines are not congested

- There is a significant value proposition for storage resource participation in the energy markets, as well as providing 'transmission alternatives'
  - Cost allocation will continue to be an area for discussion

NARUC Innovation Webinar Series

One webinar most months

All NARUC members and stakeholders are invited

Topic TBA

May 18, 2023 | 3:00 – 4:00 PM EST

Incorporating AI into Resilience-Informed Utility System Planning

June 20, 2023 | 3:00 – 4:00 PM EST

More webinar information will be added soon!

https://www.naruc.org/cpi-1/innovation-webinars/

NARUC thanks the U.S. Department of Energy for its support of this series.