CleanEnergy States Alliance

Leveraging Federal Funding for Transmission Technologies and Renewable Energy Integration

August 22, 2023

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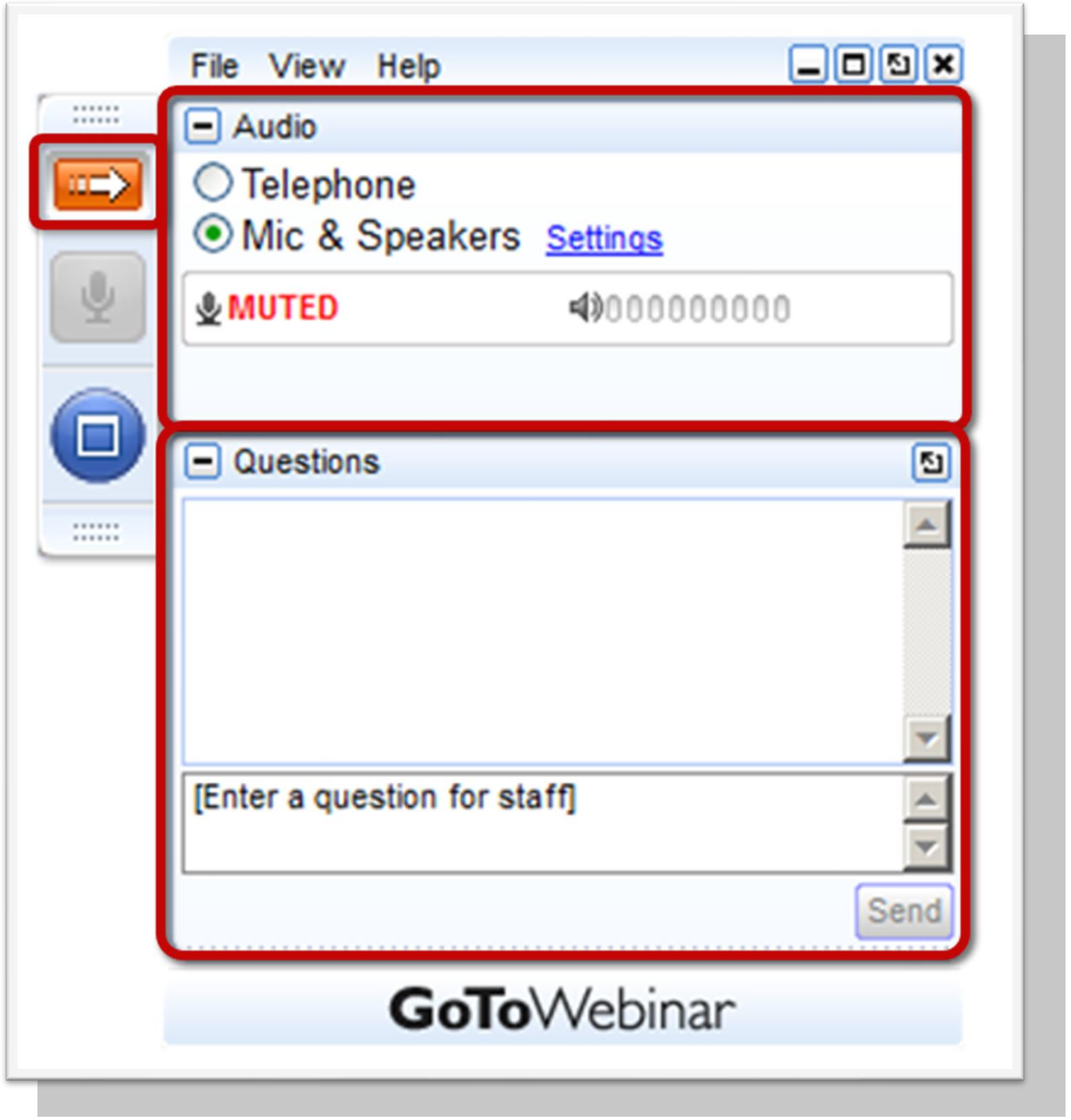

Celebrating 20 Years of State Leadership

20 Clean Energy States Alliance

The Clean Energy States Alliance (CESA) is a national, nonprofit coalition of public agencies and organizations working together to advance clean energy.

CESA members—mostly state agencies—include many of the most innovative, successful, and influential public funders of clean energy initiatives in the country.

www.cesa.org

CleanEnergy States Alliance

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State of California Energy Commission

Connecticut Green Bank

Department of Energy & Environment

Energy Trust of Oregon

IPA Illinois Power Agency

Maine Governor's Energy Office

State of New Hampshire Department of Energy

Massachusetts Clean Energy Center®

Maryland Energy Administration

EGLE Michigan Department of Environment, Great Lakes, and Energy

New Jersey Board of Public Utilities (BPU)

New Jersey's cleanenergy program™ njcleanenergy.com

New Mexico emnrd Energy, Minerals and Natural Resources Department

New York State NYSERDA

mn Commerce Department

SMUD™ Powering forward. Together.

State of Rhode Island Office of Energy Resources

Vermont Department of Public Service Clean Energy Development Fund

Virginia Energy

Rhode Island Commerce Corporation

Commissioner Stephanie Garcia Richard New Mexico State Land Office

Illinois Commerce Commission ICC

OEI Wisconsin Office of Energy Innovation

Prairie Island Indian Community in the State of Minnesota

Washington State Department of Commerce

Connecticut Energy Environment

DOER Massachusetts Department of Energy Resources

Oregon Department of Energy

Colorado Energy Office CEO

Inclusive Prosperity Capital

MassDEP

OPC-DC Office of the People's Counsel Advocacy | Education | Protection

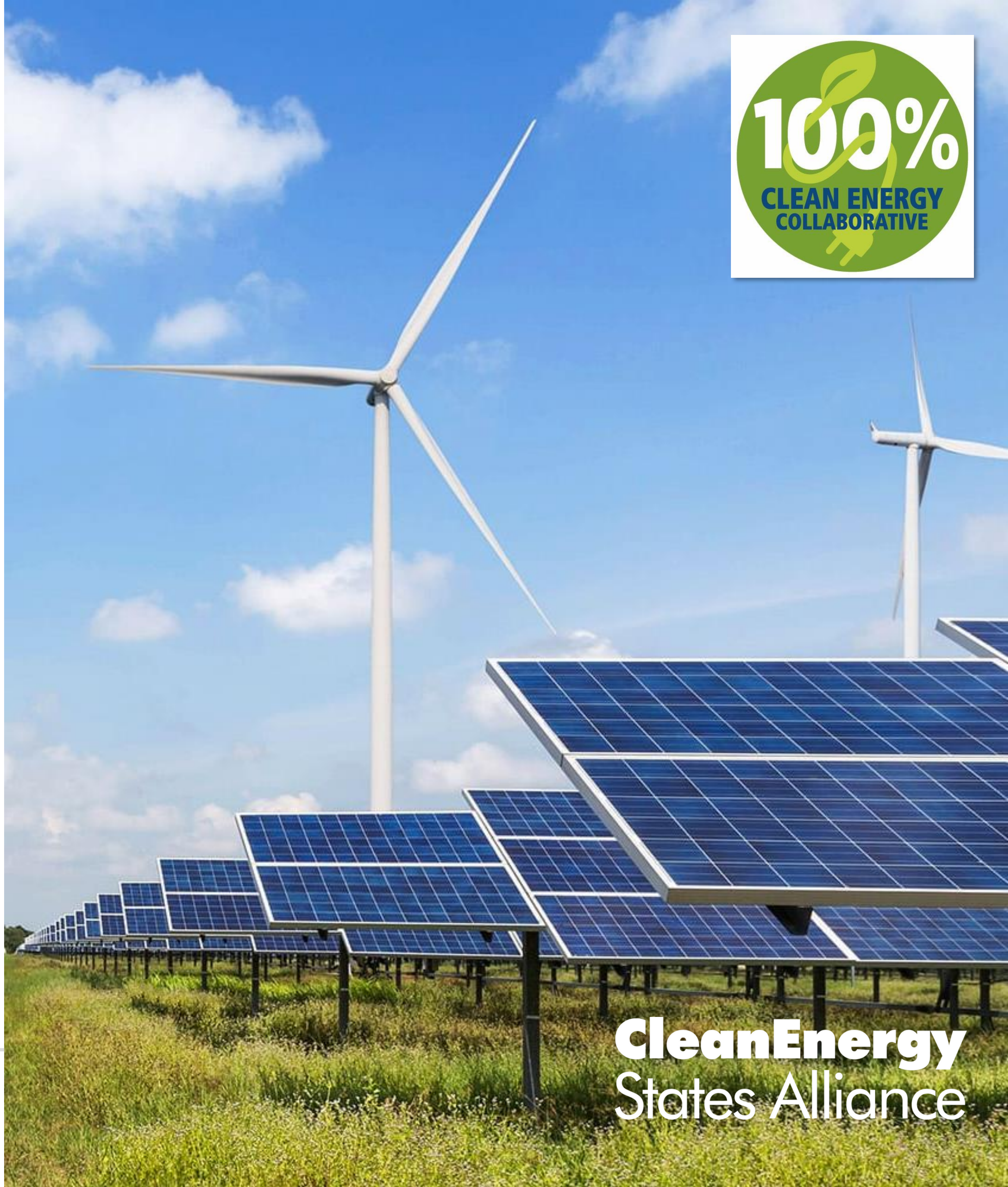
100% Clean Energy Collaborative

Assisting the 22 states (plus DC and Puerto Rico) that have 100% clean energy goals by providing knowledge-sharing activities and analysis so that together they can address program challenges and opportunities.

Resources include a monthly newsletter; a web-based *Guide to 100% Clean Energy States*; frequent public and private webinars; and numerous reports.

Clean Energy States Alliance | UNITED STATES CLIMATE ALLIANCE

www.cesa.org/100



IRA & BIL Implementation

Helping states navigate opportunities surrounding the Inflation Reduction Act and the Bipartisan Infrastructure Law.

Providing states with information, tailored guidance, and opportunities for collaboration to capitalize on billions of dollars in federal clean energy opportunities.

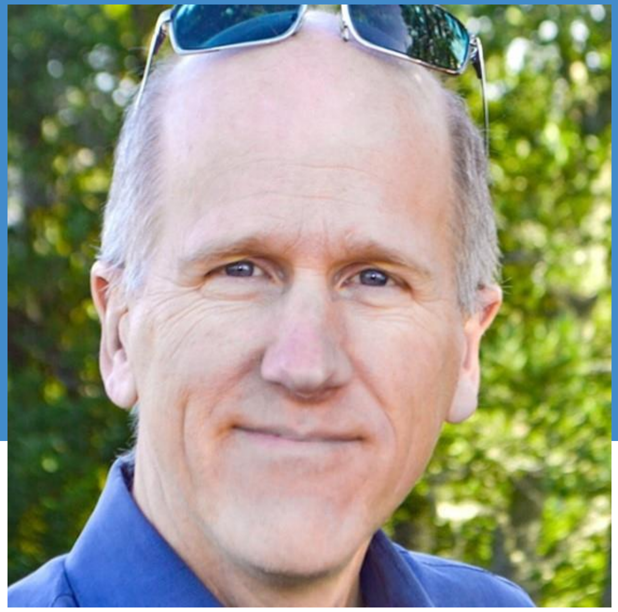
www.cesa.org/projects/ira-bil-implementation

Webinar Speakers

Mike Razanousky
Senior Project Manager, NYSERDA

Joseph Lookup
Director of Asset Management, PPL Corporation

Julia Selker
Executive Director, the Working for Advanced Transmission Technologies (WATT) Coalition



Bentham Paulos
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NEW YORK STATE | NYSERDA

ppl

WATT COALITION
Working for Advanced Transmission Technologies

CleanEnergy States Alliance

Clean Energy States Alliance

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www.cesa.org

Upcoming Webinars

An Equitable Solar Access Pilot Project in Minnesota benefitting Manufactured (Mobile) Home Residents (8/31)

Energize Your Impact: How Funders & Donors Can Support Equitable Solar Power (9/6)

Predevelopment Funding for LMI Solar and Storage Projects: A Case Study from New York (9/19)

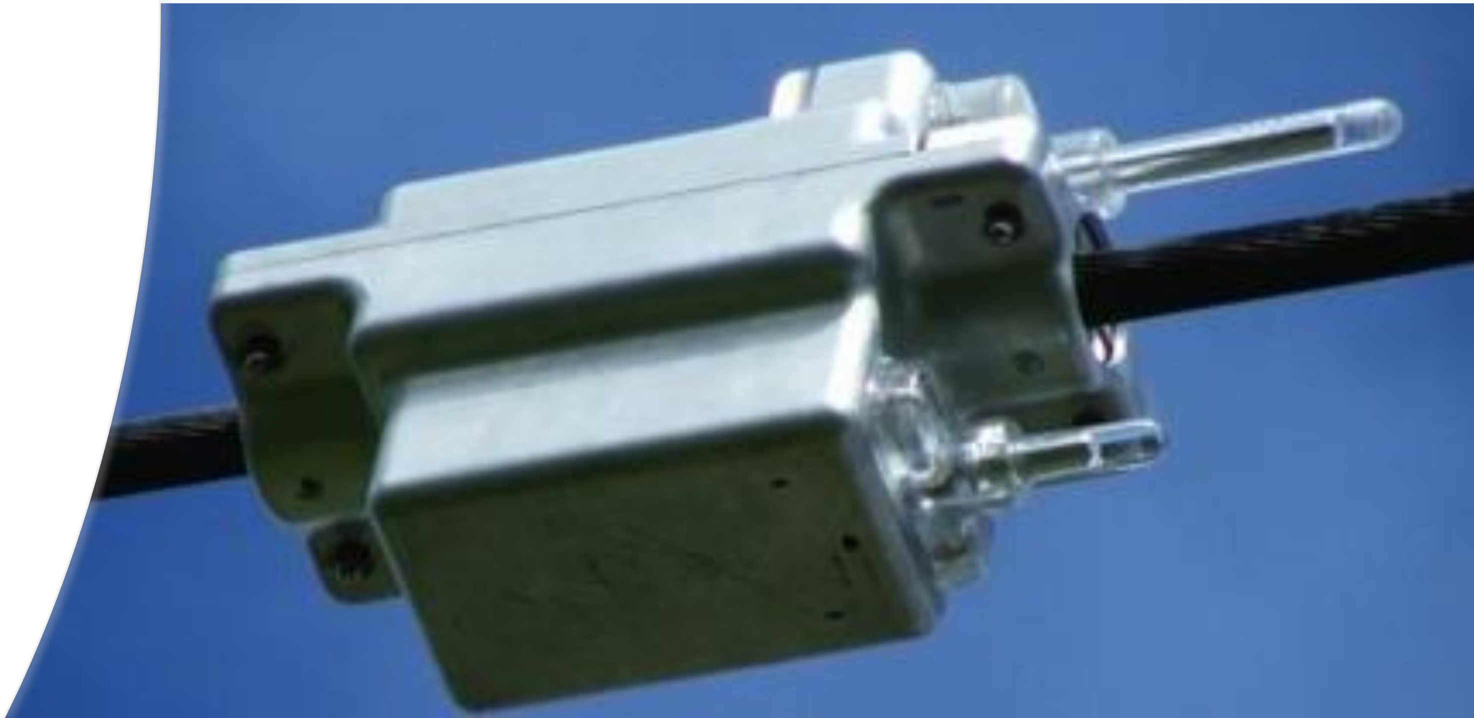
Read more and register at
www.cesa.org/webinars

Grid Enhancing Technologies

August 22, 2023

Dynamic Line Rating Systems

- **<u>Contact – (Tension, Temperature)</u>**
  - Ampacimon
- **<u>Weather</u>**
  - Wind Sim
- **<u>Lidar</u>**
  - Line Vision



Dynamic Line Rating Projects

Demonstrations in NY – Building on FERC 881 Order (Ambient Air)

Avangrid

- Line Vision & Wind Sim Démonstrations

National Grid

- Maintenance – Line Vision

Contact

- Other state utilities have demonstrated in past

Power Flow Controls

Devices

- Phase Shifting Transformers (PST)
- Series Reactors
- Distributed Series Compensators (DSC)
- Series Capacitors
- Unified Power Flow Controllers (UPFC)
- High Voltage Direct Current (HVDC)
- Energy Storage (ES)

Power Flow Controls

Demonstrations in NY

- Static Var Compensator - ABB
  - Marcy - NYPA
- PST
  - Linden Generator – Con Edison
- DSC - Smart Wires
  - Mobile Unit – Avangrid
  - Permanent – CHG&E

Controlled voltage 345 kV SVC rating 300 Mvar inductive to 270 Mvar capacitive Control system Three-phase voltage control by means of a voltage regulator Thyristor valves Water/glycol cooled three-phase valves with indirect firing

Energy Storage – Transmission & Distribution Applications

NY BEST SATA Study - Use Cases in NY

Use Case 1:
N-1 Security Constraint Management

- Under summer and winter peak conditions, Y-50 will be 119% and 117% overloaded, respectively.
- Study shows that SATA can increase the transfer limit by approximately **200 MW**.
- Implementation of SATA can increase the utilization of the interface between Zones I & J and Zone K by **1,547 GWh** over 1 year.

Use Case 2:
Voltage Support Services

- In a scenario where up to 3 generators go down, SATA has increased the utilization of the Central East interface from **22,000 GWh to 23,000 GWh.**
- Without the SATA, the Central East interface is congested for **3,037 hours**, and the congestion cost is **$142M**;
- With the SATA, the total congestion drops to **2,028 hours**, and the congestion cost is **$91M**

Use Case 3:
Example of Reduced Local Capacity Requirement

- In the case of a **double outage** (M51 and M52), the transfer limit without SATA was 2,645 MW, while the transfer limit with SATA was 2,974 MW.
- With the incremental 329.5 MW in the TSL, **Zone J can purchase an additional 329.5 MW capacity** from upstate New York and **reduce the LCR requirement by 329.5 MW**, which is by around 2.9%.

Energy Storage – Potential Study

Examines energy storage as an **alternative solution** to address **specific grid needs,** which can defer investment in costly traditional wire solutions.

- The use cases in this paper rely on **identifying potential bottlenecks** or specific locations on the grid that are **prone to failure** (i.e. identifying a specific grid need that energy storage can address).
- The **additional capacity needed** to address the grid need will **inform the optimal sizing** of the storage system.
- Production cost modeling with 8,760 hours of operation may inform project costs and benefits, once optimal size of battery is identified.

Further consideration is needed to understand and model energy storage for long-term planning purposes.

- Alongside thinking about how storage can address certain problems, we need to **model the characteristics and behavior** of energy storage technologies so that they **reflect the capabilities of these resources in long-term planning studies**.
- How do we model energy storage such that we can be confident that the power system models are **correctly simulating** the **operations (individually and in coordination) of numerous storage resources**?
  - What criteria are important and must be included to model the storage resource?
  - Capacity, duration, round-trip efficiency, depth of discharge, charge/discharge speed, operating temperature, degradation, response time, etc.

Additional Information

- New York Advanced Technologies Working Group – Task Forces (ES, DLR, & PFC)

https://jointutilitiesofny.org/advanced-technologies-working-group

- New York Power Authority's Agile Lab

https://www.nypa.gov/innovation/digital-utility/agile-lab

- NYSERDA Funding Opportunities - PON 4393 – Future Grid- GETs

https://www.nyserda.ny.gov/All-Programs/Grid-Modernization-Program

Thank You

Michael Razanousky

NEW YORK STATE OF OPPORTUNITY. | NYSERDA

Clean Energy States Alliance (CESA) Grid Enhancing Technologies Webinar

Joseph Lookup – Director of Asset Management

What is DLR

DLR is a system of installed line sensors used to measure conductor and environmental real time data to determine a real time rating instead of assumed condition values.

Traditional Line Ratings (Existing)

Assumes:

- Wind speed
- Ambient Temperature
- Solar Radiation

Ratings:

- Seasonal ratings – Planning limitations
- Ambient Adjusted (Operations)
  - Conservatively Calculates Ratings

Dynamic Line Ratings

Measures:

- Wind speed
- Ambient Temperature
- Conductor Temperature
- Conductor Sag

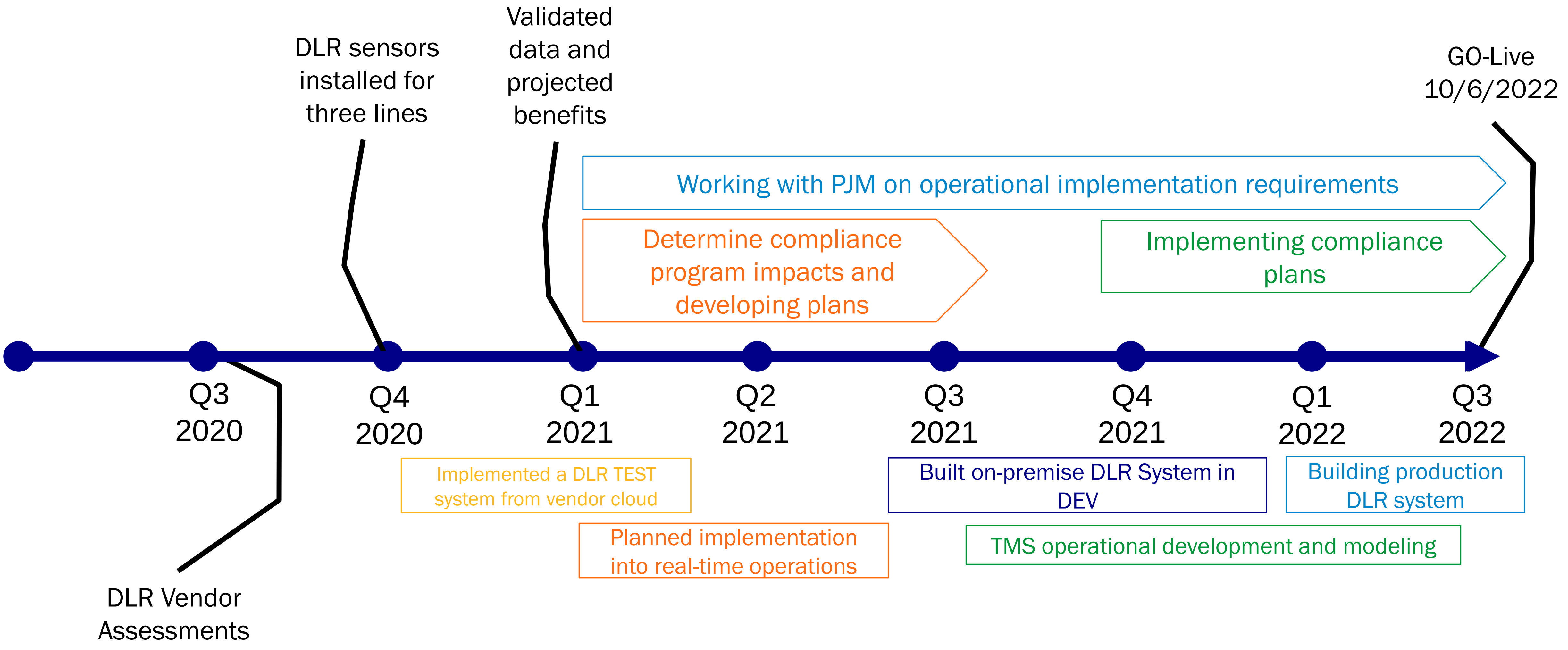
Ratings:

- Provides accurate Real-Time Ratings
- Allows forecasted ratings

Asset Health:

- Measures conductor health

Our Roadmap So Far….



Transmission Planning – Congestion Solution

Step 1: Identified need(s) on transmission lines

Step 2: Alternative Analysis

Step 3: Asset management/economic analysis

Step 4: Submitted in PJM market efficiency window

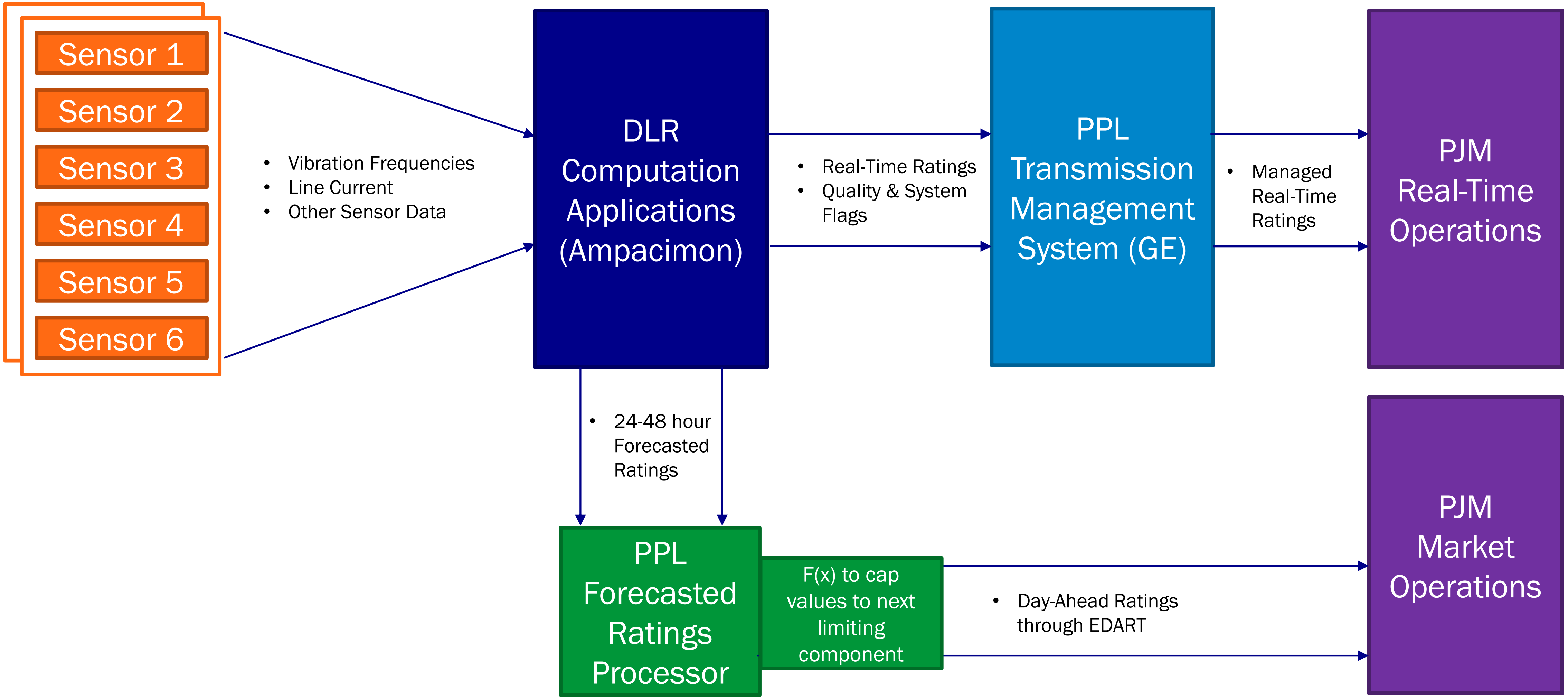
Step 5: Full study with our RTO to confirm

2020/21 RTEP Market Efficiency Window Eligible Energy Market Congestion Drivers* (Posted 03-05-2021)				ME Base Case (Annual Congestion $million)		ME Base Case (Hours Binding)	
FG#	Constraint	FROM AREA	TO AREA	2025 Simulated Year	2028 Simulated Year	2025 Simulated Year	2028 Simulated Year
ME-1	Kammer North to Natrium 138 kV	AEP	AEP	$ 2.02	$ 6.56	69	167
ME-3	Junction to French's Mill 138 kV	APS	APS	$ 9.18	$ 11.97	276	301
ME-4	Yukon to AA2-161 Tap 138 kV	APS	APS	$ 4.36	$ 5.16	1742	1958
ME-5	Charlottesville to Proffit Rd Del Pt 230 kV	DOM	DOM	$ 3.76	$ 4.96	121	124
ME-6	Plymouth Meeting to Whitpain 230 kV	PECO	PECO	$ 3.33	$ 4.09	111	101
ME-7	Cumberland to Juniata 230 kV***	PLGRP	PLGRP	$ 9.00	$ 6.61	213	179
ME-8	Harwood to Susquehanna 230 kV***	PLGRP	PLGRP	$ 14.49	$ 8.69	830	501

Result:

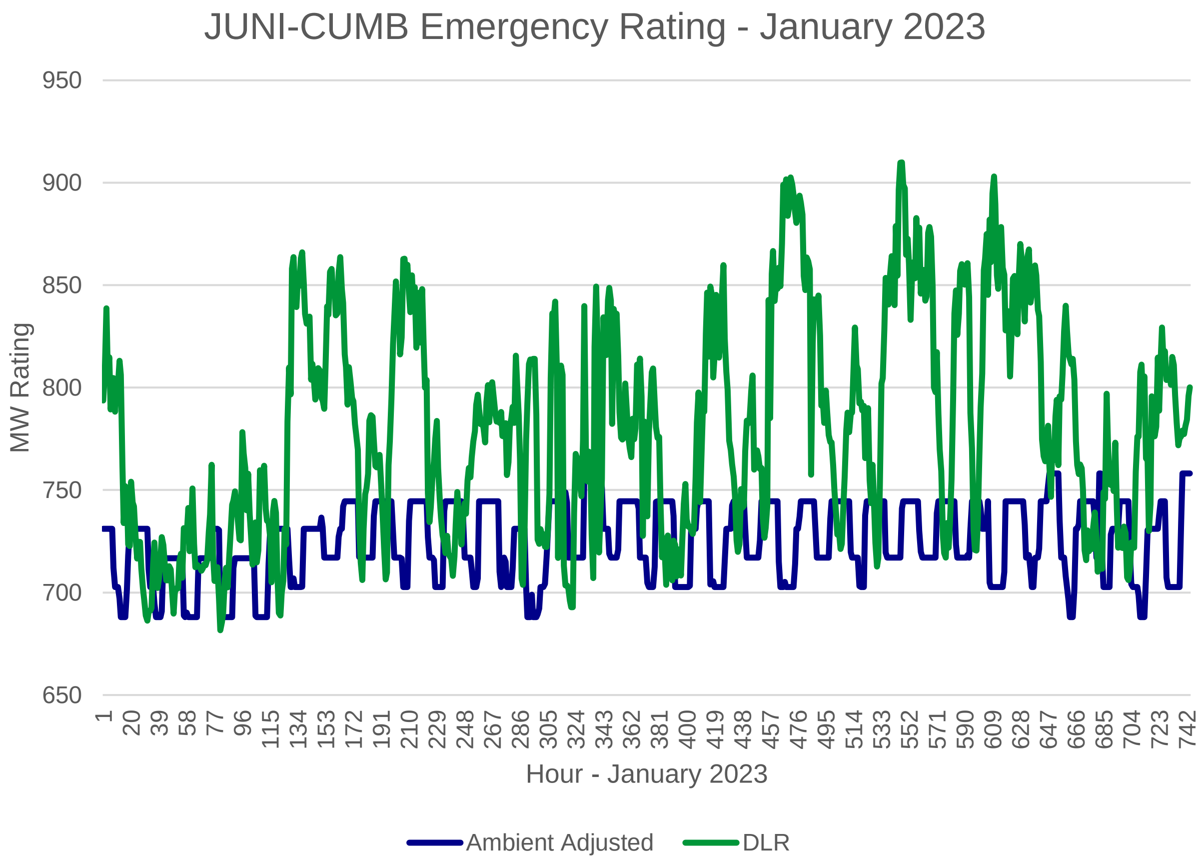
Awarded PJM in market efficiency project

Ratings Data Flow



Juniata –Cumberland Results

- Live Since October 2022
- Increase in Ratings:
  - ~18% Average Normal Rating
  - ~10% Average Emergency Rating
- Saved customers over $60 million in Congestion generation costs



PPL leads the way in Dynamic Line Ratings (DLR)

- To resolve market efficiency and congestion issues non-wired solution
- Utilized into real-time operations in our Transmission Management System (TMS)
- Integrated DLR into Regional Transmission Organization (RTO) real-time energy market, during October 2022

Estimated to save customers over **$23 million** in congested generation costs **annually**

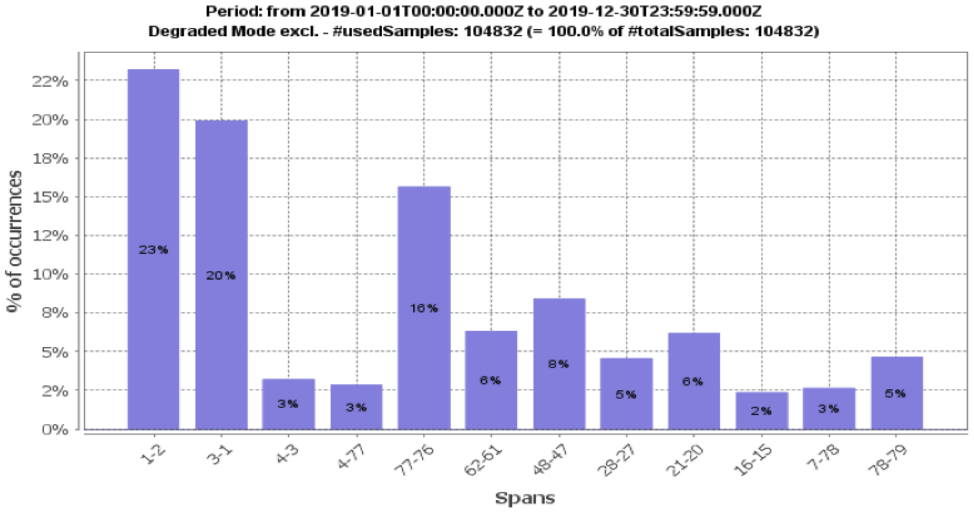
Challenges: Solved and Ongoing

- NERC standards impacts and processes
- Ratings management:
  - Failure contingency
  - Honoring next most limiting component
- Regional transmission operator and stakeholder coordination
- Best practices for ratings validation
- Ratings methodologies industry best practices:
  - Real-time
  - Long-term forecasts
- Large scale system considerations, risks and mitigations

Thank you

Targets Span Identification

1 Critical Span Distribution From DLR Simulation



2 Required Span Selection Rules

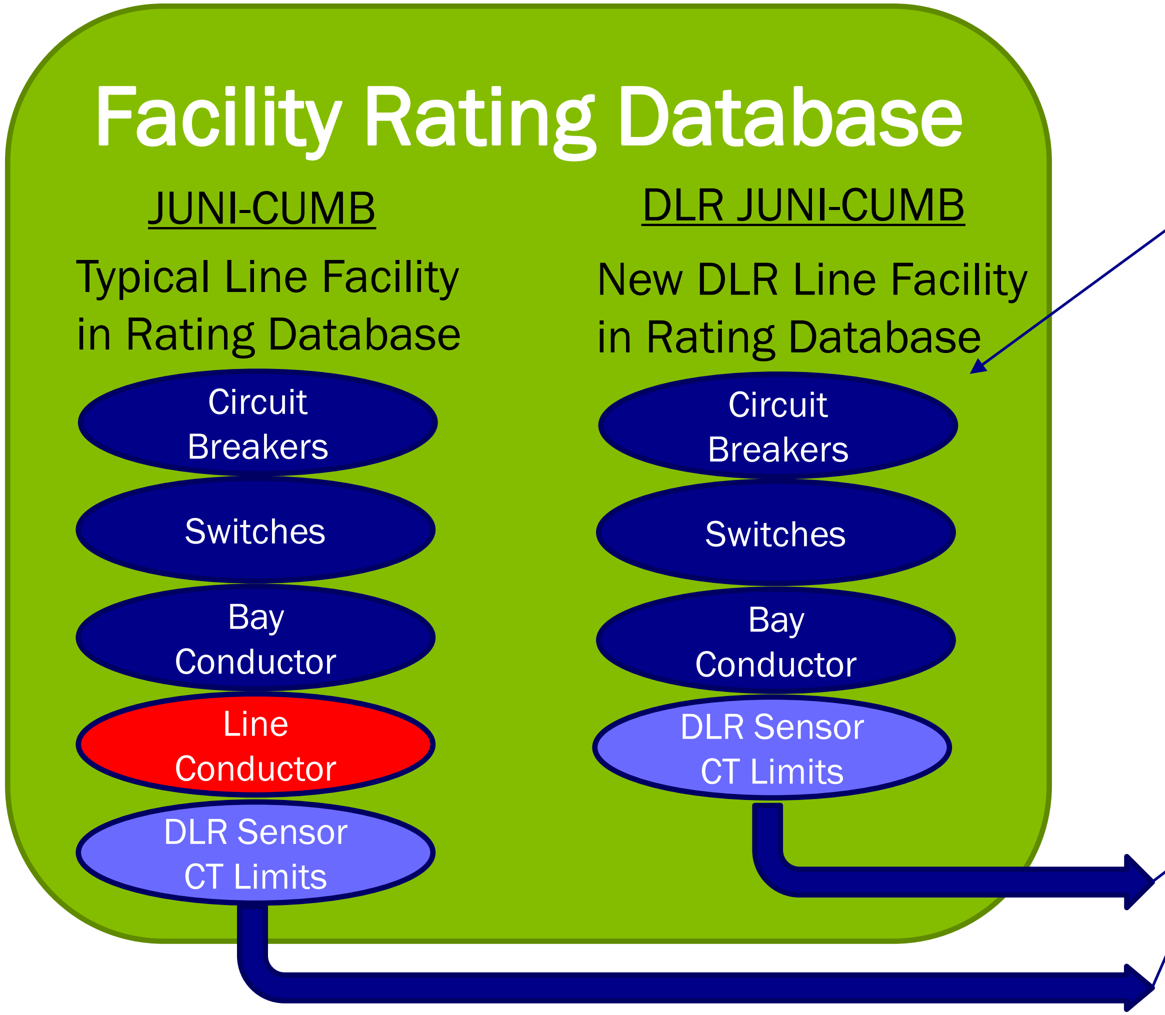
- Orientation between spans changes more than 15°
  - → To capture variability in wind direction
- Distance is greater than 6.2 miles (10 km)
- Conductor or number of sub-conductor change
- Span safety concerns
- Utility span data identifies high risk span(s)

3 Final Span Selection

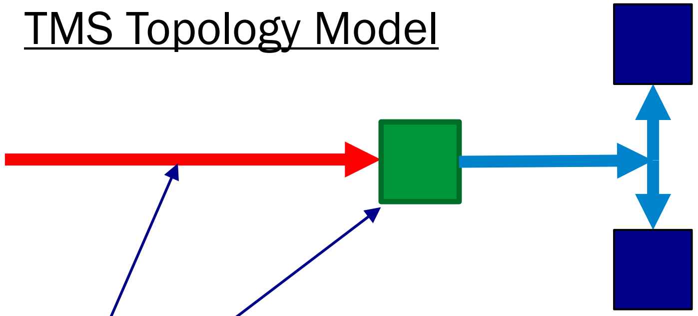
4 Installation

- One phase per identified span
- Sensor mounted 5 – 10% of the total span length from either tower
- Live Line Installation Via Helicopter and from ground
- Mounting procedure is 5 - 10 minutes per sensor

FAC-008 Operations Considerations



A duplicated line facility is created when DLR is applied to a line. The line conductor ratings are removed in this facility since the line conductor's rating will be dynamic.



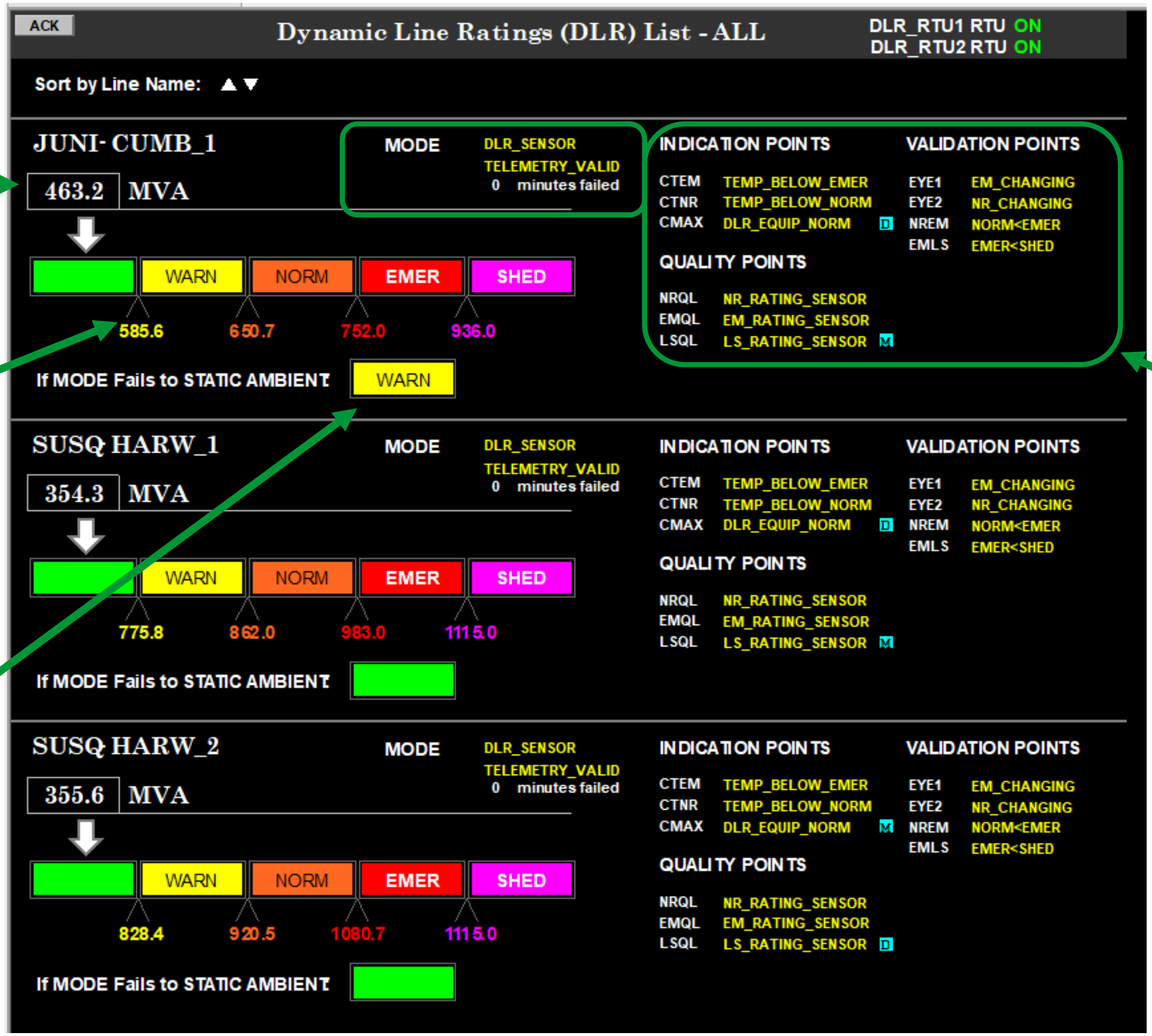
These are used as next most limiting component ratings to limit any ratings received from DLR.

TMS Operator Display

Current line loading

Current real-time ratings

Rating Zone if DLR goes down



Various DLR indication, validation, and quality points for situational awareness

Federal Funding for Grid Enhancing Technologies

Julia Selker, Executive Director

Working for Advanced Transmission Technologies (WATT) Coalition

8.22.2023

WATT

www.watt-transmission.org

Working for Advanced Transmission Technologies

Mission: The Working for Advanced Transmission Technologies (WATT) Coalition advocates for policy that supports wide deployment of Grid Enhancing Technologies (GETs) to accelerate the clean energy transition and lower energy costs.

Ampacimon – Smart solutions for a dynamic grid

HASI

LINDSEY SYSTEMS

SMART WIRES – REIMAGINE THE GRID

ATECNUM PowerDonut PD4

HEIMDALLPOWER

newgrid

SOLSYSTEMS

EDF renewables

Invenergy

PINEGATE RENEWABLES

vermont electric power company VELCO

ENGIE

LINEVISION

prisma photonics

windsim POWER

DOE programs for GETs deployments - $14B total

- Preventing Outages and Enhancing the Resilience of the Electric Grid Grants
  - Matching grants for industry - 40101(c)
  - State and tribal formula grants - 40101(d)
- Smart Grid Investment Grants – 40107
- Grid Innovation Program - 40103(b)
- Energy Improvement in Rural & Remote Areas Program (ERA) - 40103(c)

First round awards expected Q3/4 2023, new opportunities Q1 2024

https://www.energy.gov/gdo/grid-and-transmission-program-conductor-guide

Groundwork for Grants

States are grantees in 40101(d), Smart Grid, Grid Innovation, ERA

- Partner with technology vendors
- Partner with your utilities

Utilities are grantees in 40101(c), Smart Grid, ERA (nonprofits only)

- Push utilities to pursue funding – open dockets, write letters

Other state leverage on grid optimization

- FERC Order 881, Order 2023 implementation
  - 881: Upgrade systems to use DLR in addition to AAR
  - 2023: Utilities have full discretion on how to evaluate and implement transmission technologies
  - And beyond: MISO Congestion Reconfiguration Process, ERCOT economic transmission planning

- Pursue funding for *studies* that utilities will use to deploy GETs
  - A study of the KS and OK grids found $90m in GETs deployments would unlock 2,500 MW of renewable development - $175m/year in benefits

Working for Advanced Transmission Technologies

WATT

For more information contact

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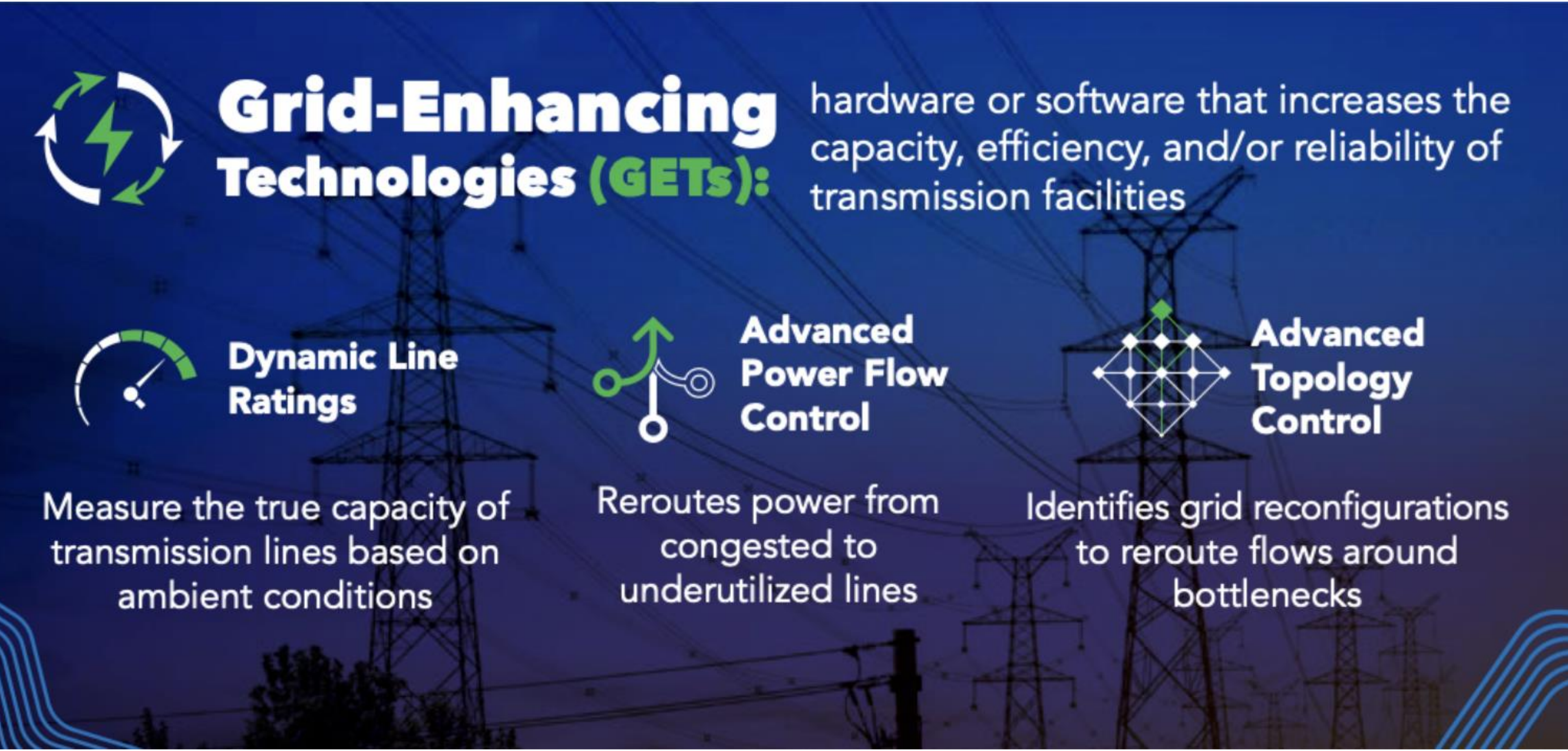
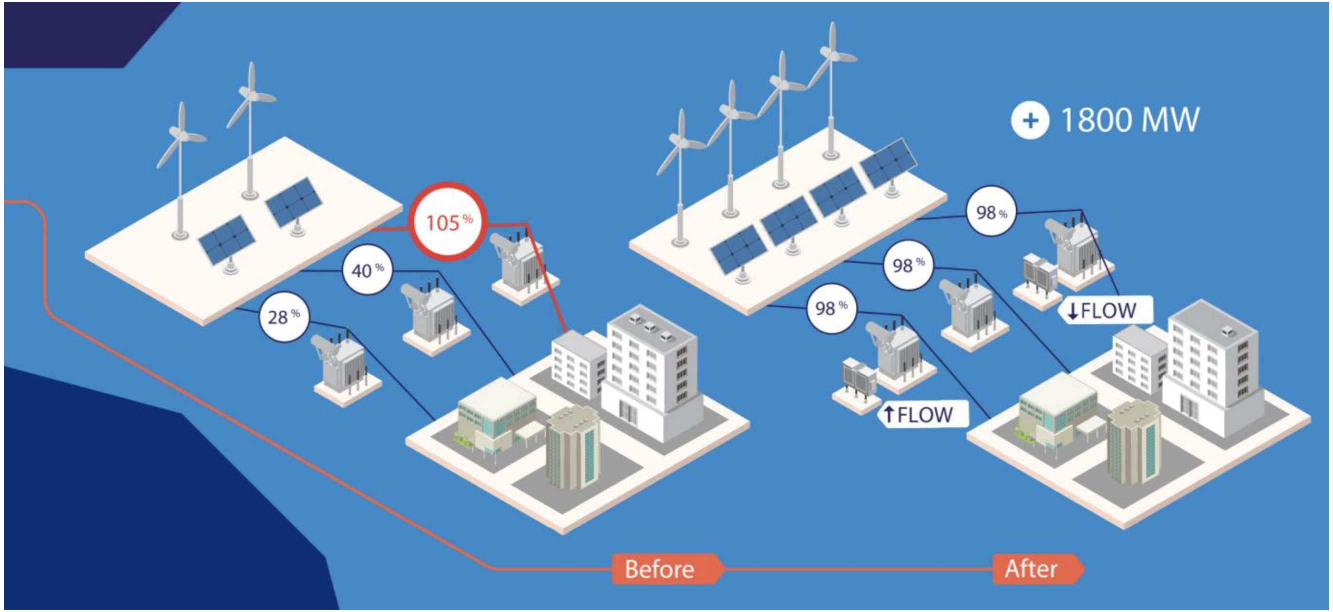
www.watt-transmission.org

Appendix

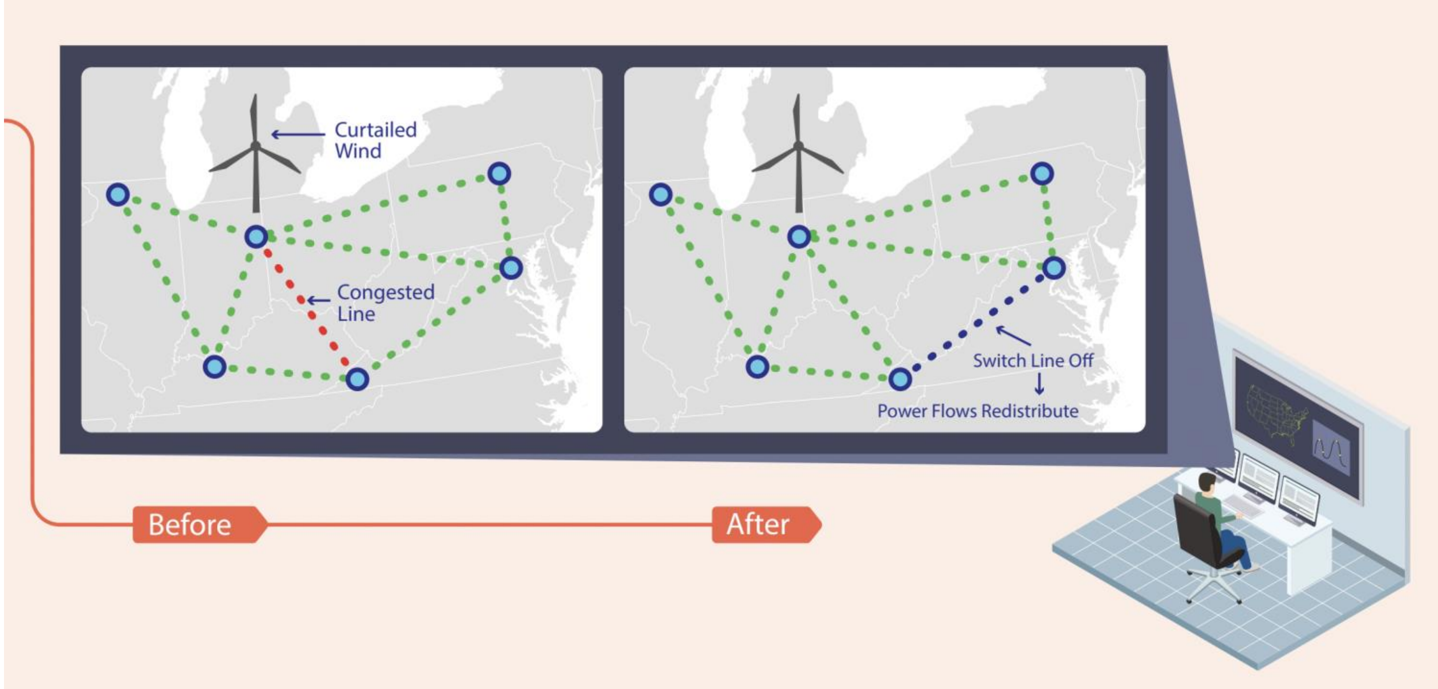

Grid-Enhancing Technologies (GETs):
hardware or software that increases the capacity, efficiency, and/or reliability of transmission facilities
Dynamic Line Ratings
Advanced Power Flow Control
Advanced Topology Control
Measure the true capacity of transmission lines based on ambient conditions
Reroutes power from congested to underutilized lines
Identifies grid reconfigurations to reroute flows around bottlenecks

Advanced Power Flow Control



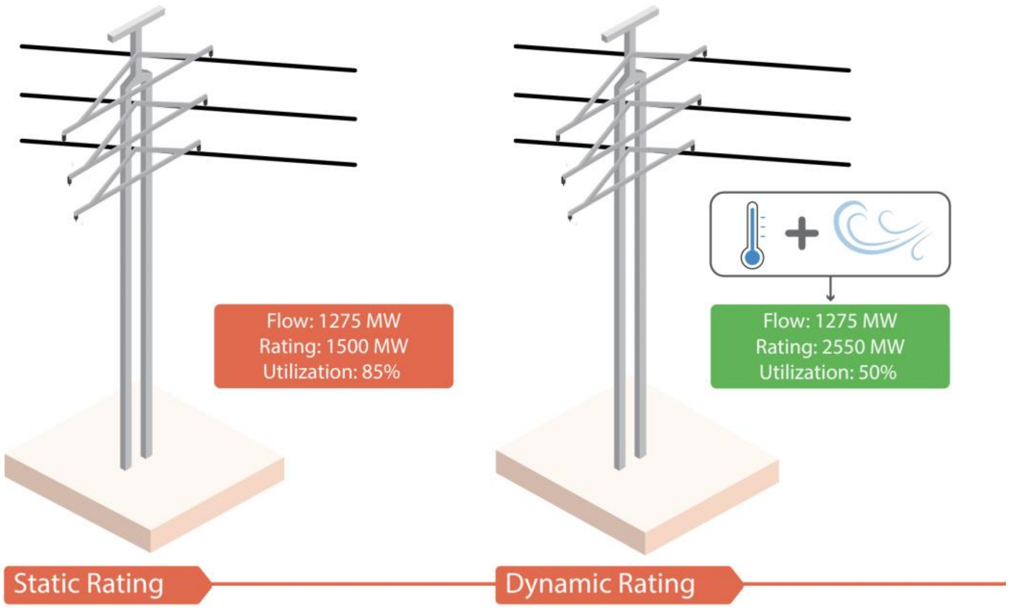
Deployments in the UK by National Grid unlocked capacity for
[1.5 GW of new renewable energy saving UK ratepayers over $500 million]

Topology Optimization



[Topology optimization reduced curtailment of one wind farm by 77%]

Dynamic Line Ratings



Results from 2021 deployment in 3 states:

DLR exceeded static reference ratings by

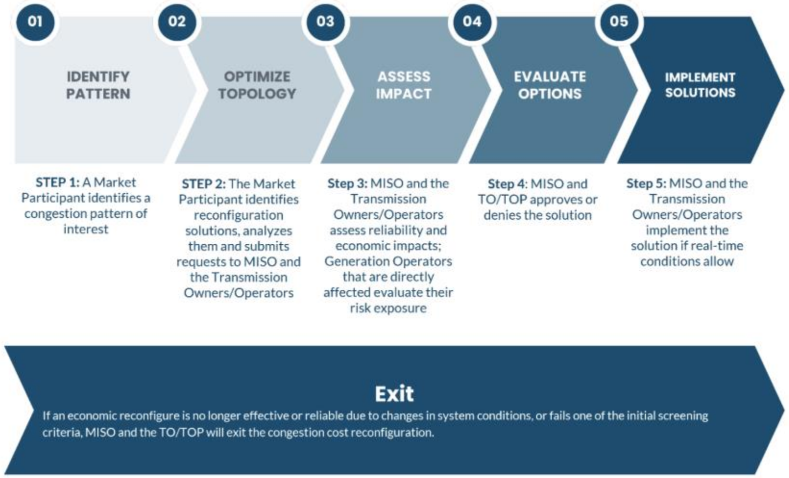
- **9-33% in winter**
- **26-36% in summer**

DLR exceeded static ratings over 85% of the time

From *A Guide to Case Studies of Grid Enhancing Technologies*

GETs going mainstream:

- MISO reconfiguration process to reduce congestion costs



- PPL wins 95th Edison Award for DLR integration

- ERCOT evaluates DLR in economic transmission planning to resolve congestion

Benefits of Grid Enhancing Technologies (GETs)

Economic, Reliability and Clean Energy Benefits

Cost Savings

- Decreased congestion costs – estimated savings of *$2-4 billion per year*
- Lowest cost increase in transmission capacity – often >20% average increase
- GETs are very low cost: roughly $0.5k - $25m per installation
- Increased capacity enables lower-cost renewable generation

Cleaner energy, faster

- GETs can double the integration of new renewable energy capacity of a transmission system, without any new lines
- GETs deploy in months for rapid energy transition

Reliability through flexibility and awareness

- Data-driven decisions, real-time visibility, and enhanced control over the system support reliable grid operation

Barriers to Adoption

Why are these beneficial technologies not being used?

Awareness

- Many planners, utility executives, regulators, and stakeholders are unfamiliar with advanced transmission technologies and their benefits

No Incentive to Innovate

- Can't be blamed for doing things the same way as usual
- Lower returns on lower capital cost expenditures

Advanced Power Flow Control

Meets current flexibility needs

- — A set of technologies that effectively pushes or pulls power away from overloaded lines and onto underutilized corridors within the existing transmission network
- —Serves as a “valve” to control power flow

Technological benefits

- — Quickly deployed
- — Easily scaled to meet the size of the need
- — Able to be redeployed to new parts of the grid when no longer needed in current location

See a deployment in UK, saving customers more than £300 million and adding 1.5 GW of capacity

Dynamic Line Rating

Increases capacity on existing transmission lines

— Calculates ratings based on actual monitored conditions rather than fixed worst-case assumptions

— Even a relatively low amount of wind can cool the line, significantly increasing its rating and reducing curtailments and congestion

Improves reliability

— Provides forecasted ratings up to 48 hours ahead, and improves reliability by alerting operators to conditions such as clearance violations

— Estimates of increased capacity have been 40 percent, 30 to 70 percent, and 30 to 44 percent on three different tests

(US Department of Energy, Dynamic Line Rating Systems for Transmission Lines, April 2014, https://www.smartgrid.gov/files/SGDP_Transmission_DLR_Topical_Report_04-25-14_FINAL.pdf)

[Belgium has been managing its transmission system with widespread use of Dynamic Line Ratings for over a decade.]

Advanced Topology Control

Evenly distributes flow over the network

- — A software technology that automatically identifies reconfigurations of the grid to route power flow around congested or overloaded transmission elements
- — Reconfigurations are implemented through switching on/off existing high voltage circuit breakers
- — Optimization increases the transfer capacity of the grid

Congestion and curtailment reduction

- — Can reduce congestion by up to 50 percent and improve response to contingencies
- — Can reduce renewable energy curtailment by up to 40 percent

See the potential impact of topology optimization in MISO as presented to FERC.