

# Committee on Electricity

NARUC  Summer  
Policy Summit

# **Committee on Electricity and Task Force on Innovation**

## **Innovation Spotlight: New Transmission Technologies**

# Innovation Spotlight: New Transmission Technologies

Moderator: Hon. Brad Johnson, Montana

Speakers:

Alison Silverstein, North American Synchrophasor Initiative

Ken Blair, Ampjack Industries

David Rupert, Breakthrough Overhead Line Design (BOLD)

Todd Ryan, SmartWires



NARUC Summer Meeting 2017

# SYNCHROPHASORS & THE GRID

Alison Silverstein, NASPI Project Manager



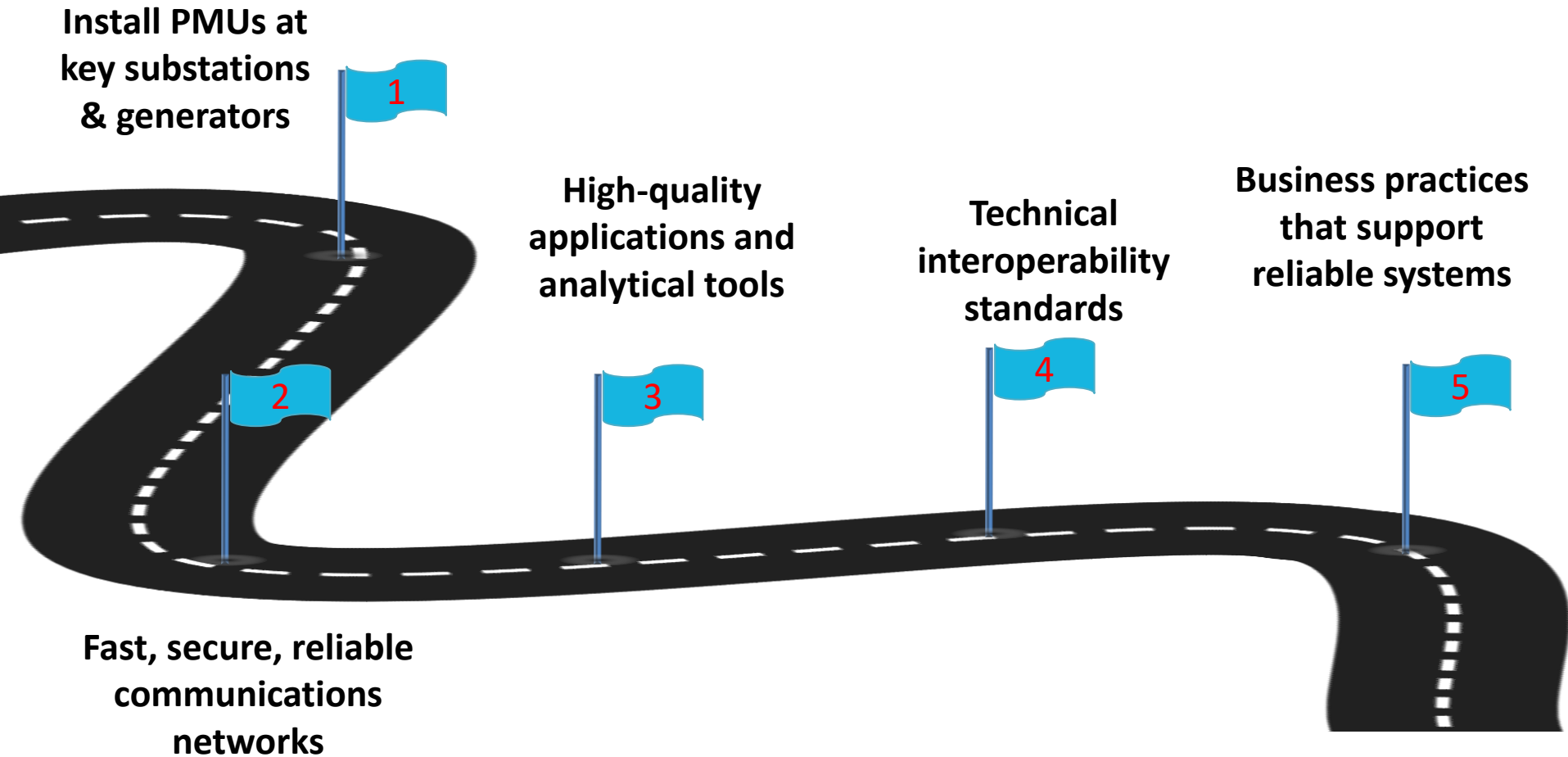
# Synchrophasor technology improves grid reliability

- 30-60 samples/second – 100 times faster than SCADA – & time-synced, provides real-time situational awareness
- Highly granular, high volumes of data enable insight into grid conditions
  - Early warning of grid events & dynamic behavior
  - Fast identification of failing equipment and asset problems
  - Better models of equipment, generators and power system
- Redundant, secure operator tools and automated system protection

# Grid visibility -- PMUs v. SCADA



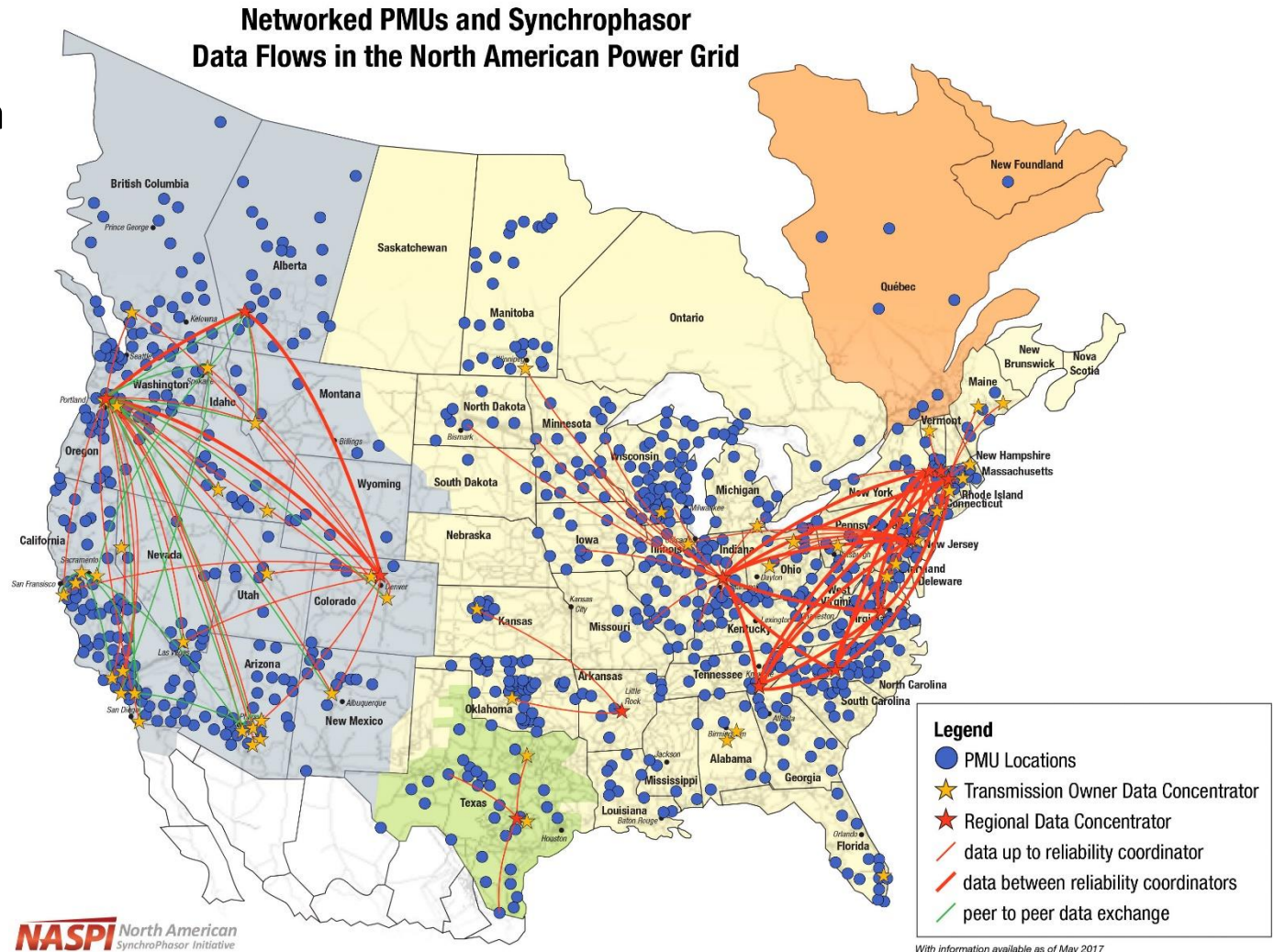
# Synchrophasor technology elements





## 2017 North America Synchrophasor networks

- Over 2,500 networked PMUS
- Most RCs are receiving and sharing PMU data for real-time wide-area situational awareness





# Current uses for synchrophasor technology

## Situational awareness

- Wide-area visualization
- Oscillation detection
- Angle monitoring
- Voltage stability monitoring
- Trending
- Event replay
- Alarms and alerts
- Linear state estimation
- Fault location

## Off-line analysis

- NERC standard compliance
- Forensic event analysis
- Model validation (equipment, generation, power system)
- Identify equipment problems
- Equipment commissioning

# A bad day in the Western Interconnection

## Event Replay of 9/8/2011 Southwest Blackout

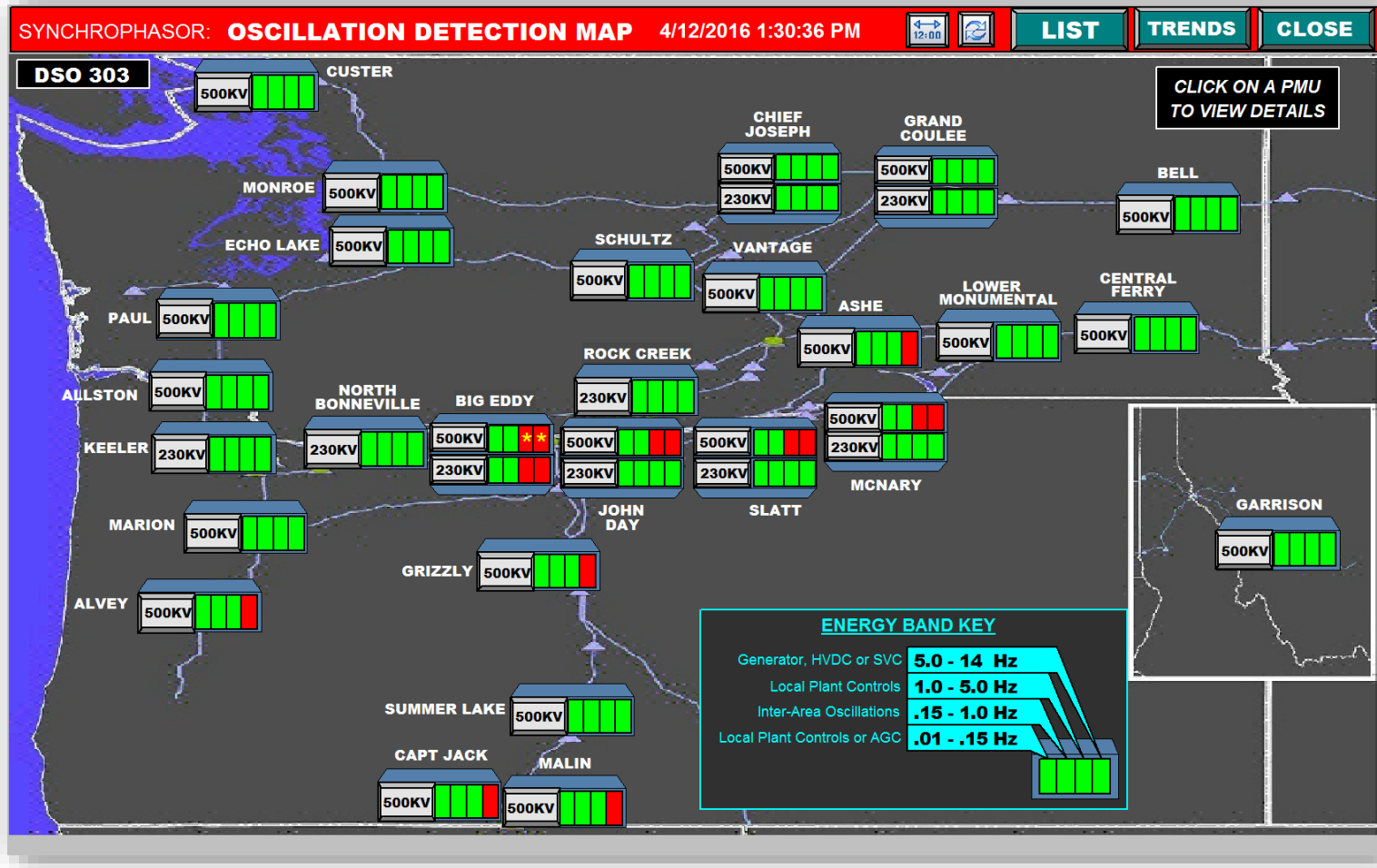
### ★ Data Source:

Power grid frequency data collected by FDRs(Frequency Disturbance Recorder)

### ★ Event Description:

On 9/8/2011, the Southwest Blackout occurred when a 500-kV line connecting Arizona with San Diego tripped following a capacitor switchout. This widespread power outage affected large areas of Southern California as well as western Arizona, northern Baja California, and Sonora. This event left nearly 7 million people without power.

# BPA oscillation detection tool



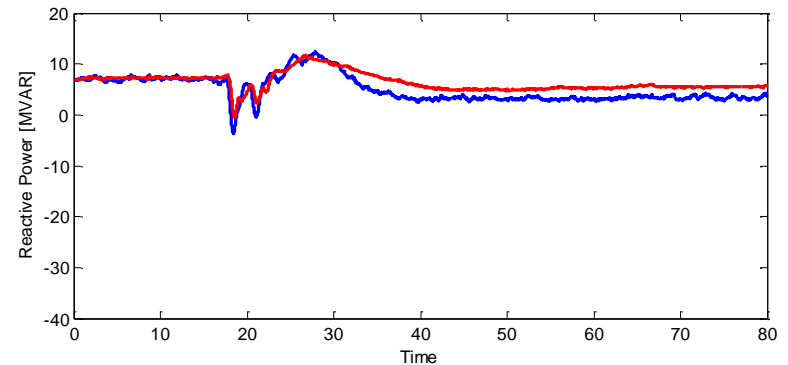
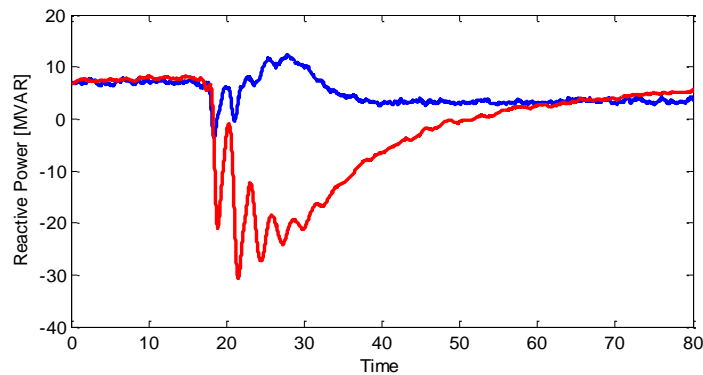
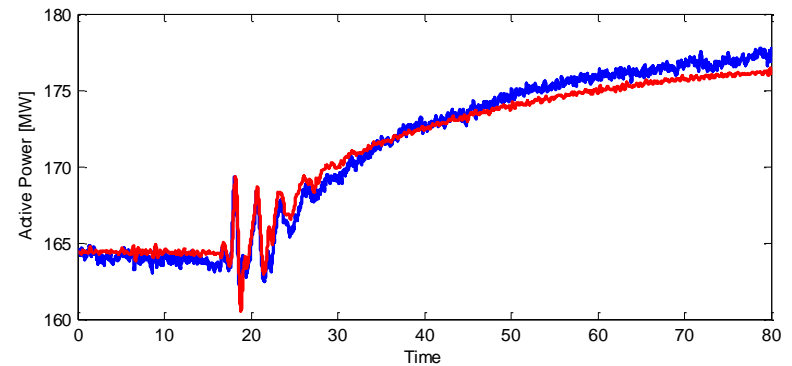
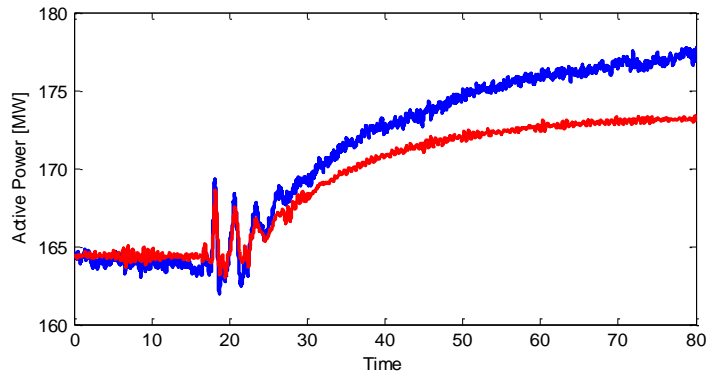
# Wind farm oscillations discovered with PMU data



# Better data yields better generator models

## BPA generator model - before (2014) and after (2015) PMU data validation

Blue – actual event recording, red = model

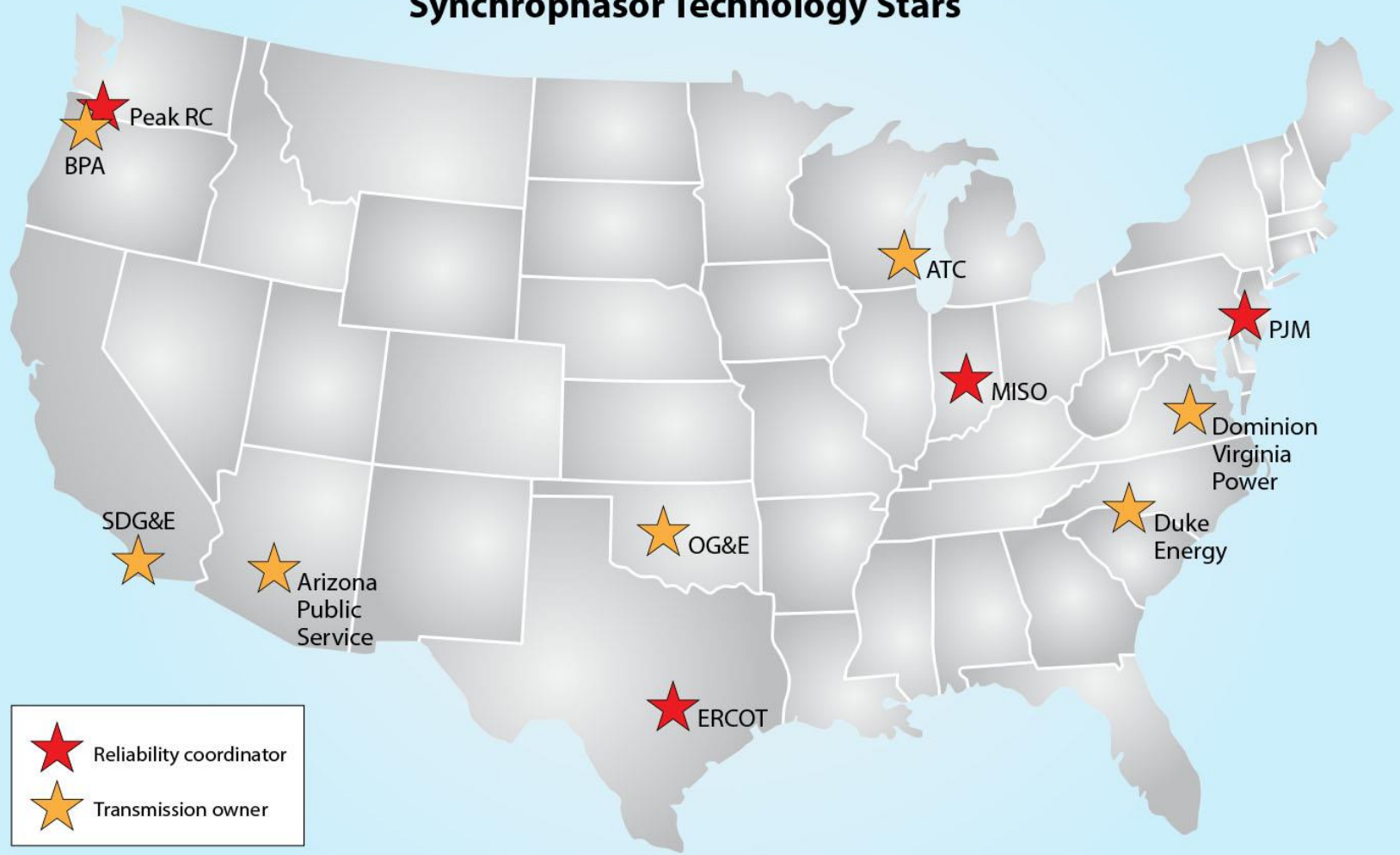


# More synchrophasor uses

- Renewables integration – modeling, oscillation mitigation, transmission management
- Dynamic line loading for greater throughput w/o more capital investment
- Baselineing – understanding “normal” and discovering new potential problems
- Electrical island detection and blackout restoration
- Automated system protection operations



## Synchrophasor Technology Stars



# What's next for synchrophasor technology

- Advanced machine learning using PMU data to identify anomalous events and develop operator decision support tools
- Automated, autonomous system protection schemes, including wide-area damping
- Distribution-level uses for synchronized grid-level measurements (e.g., for two-way grid monitoring and analysis)
- Advance PMU deployment and applications use and data-sharing across TOs and RCs



## Video credits

- PMUs v. SCADA – Electric Power Group
- Southwest blackout – FNET -- Dr. Yilu Liu, CURENT- University of Tennessee Knoxville
- Windfarm oscillations – Electric Power Group  
RTDMS

## Other credits

- Map – North American Synchrophasor Initiative
- BPA application screen captures – BPA

More information – [www.naspi.org](http://www.naspi.org)



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# THANK YOU!

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[https://www.youtube.com/user/  
TheAMPJACK](https://www.youtube.com/user/TheAMPJACK)

<https://www.youtube.com/user/AEPtv/videos>



# New Technology? Why Now?







Aging infrastructure





**Aging infrastructure**





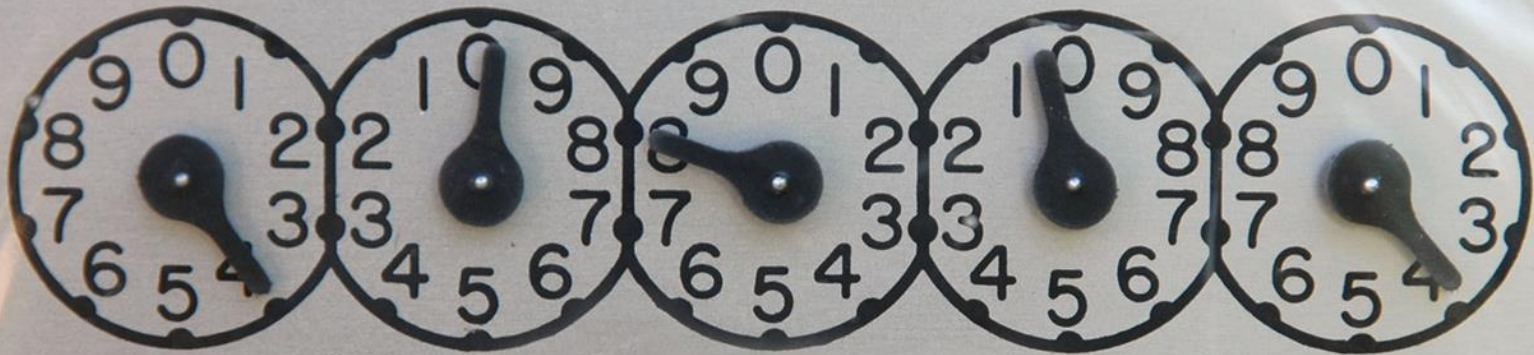
**Evolving Generation Mix**



Old Way

R<sub>r</sub> 13 <sup>8</sup>/<sub>9</sub>

KILOWATTHOURS



Smart Way





**New technology offers:**

**Higher capacity**

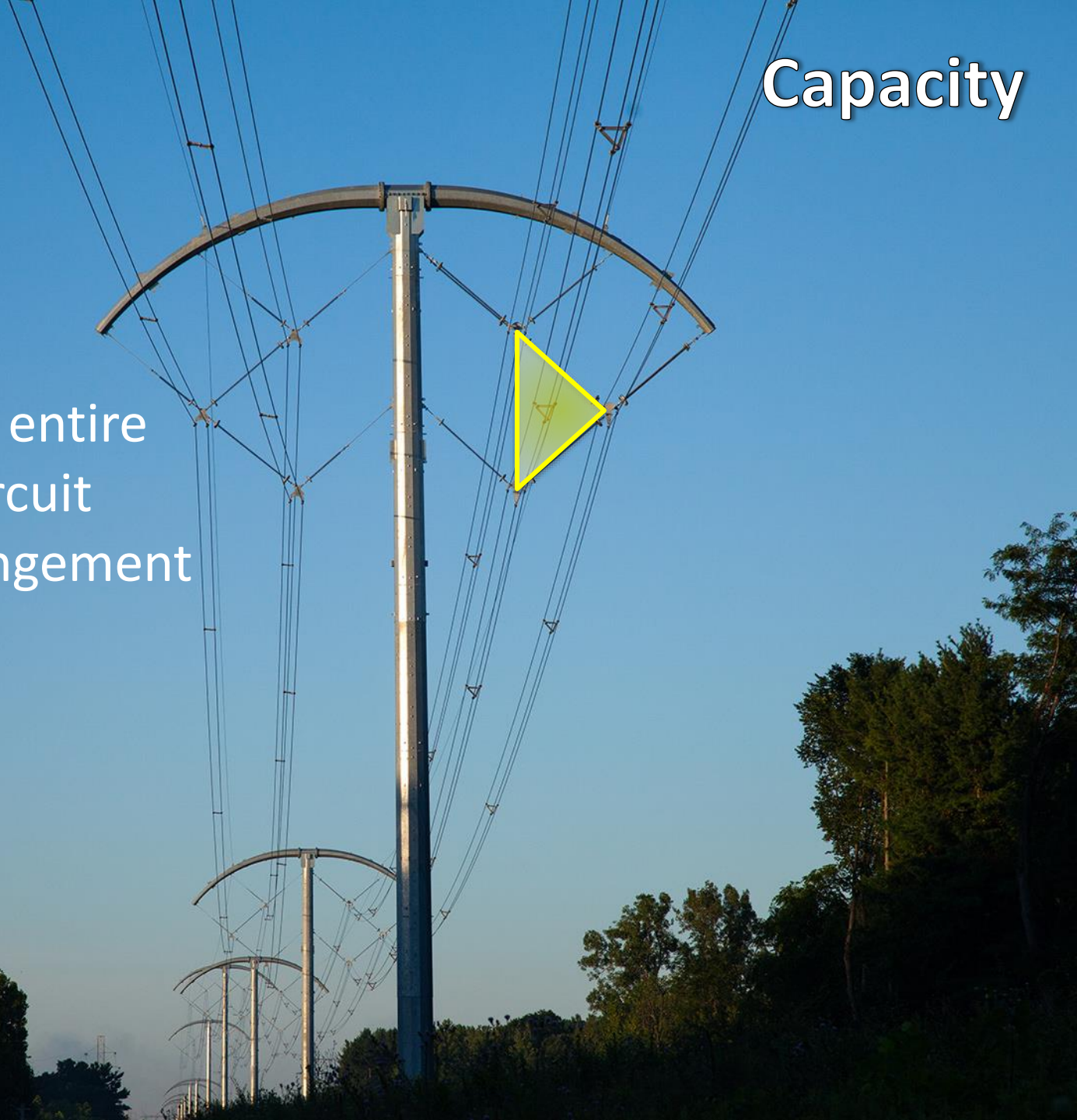
**Greater efficiency**

**Better use of existing rights-of-way**

**Faster deployment**

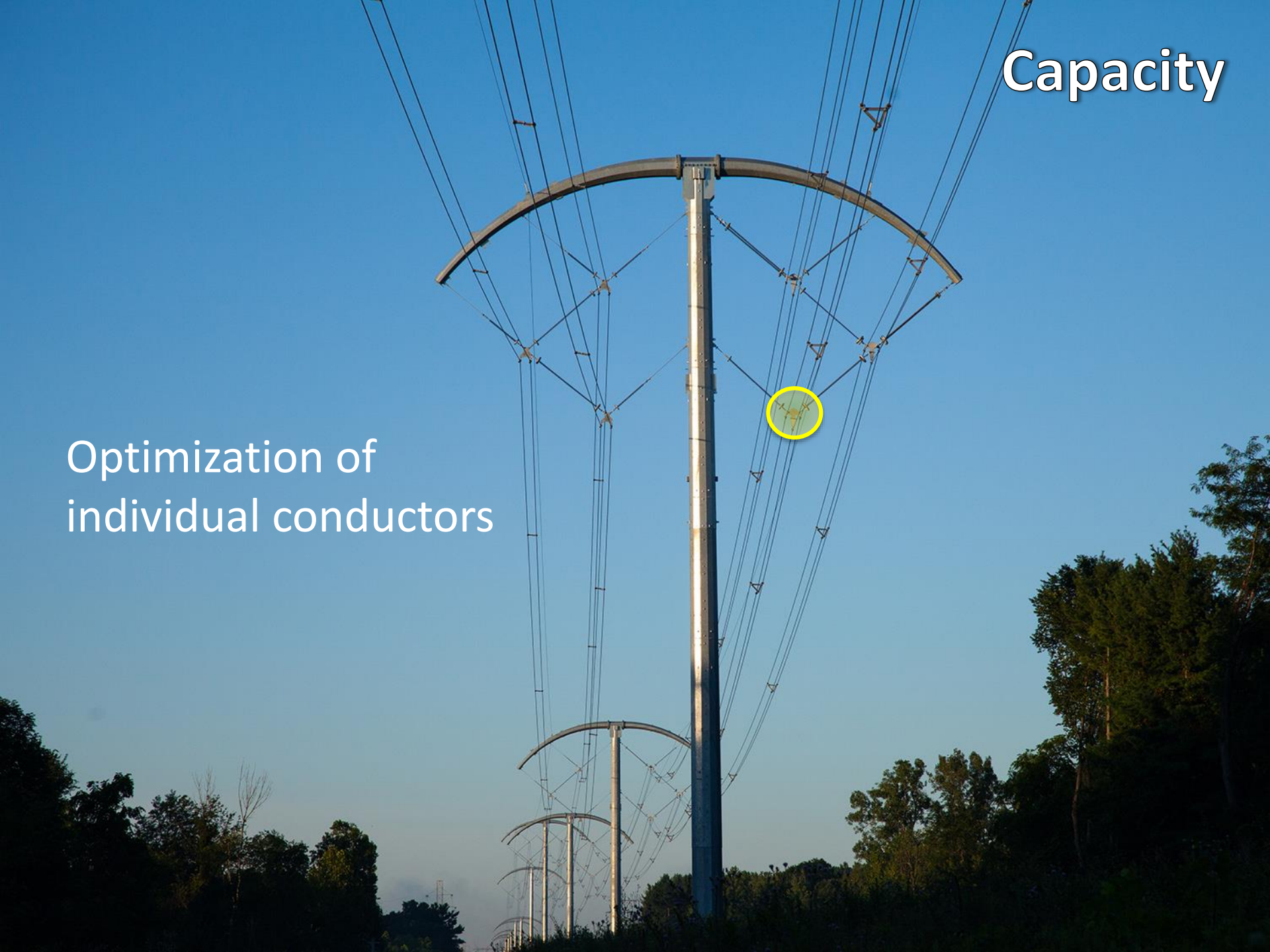
Capacity

Compaction of entire  
three-phase circuit  
into delta arrangement



Capacity

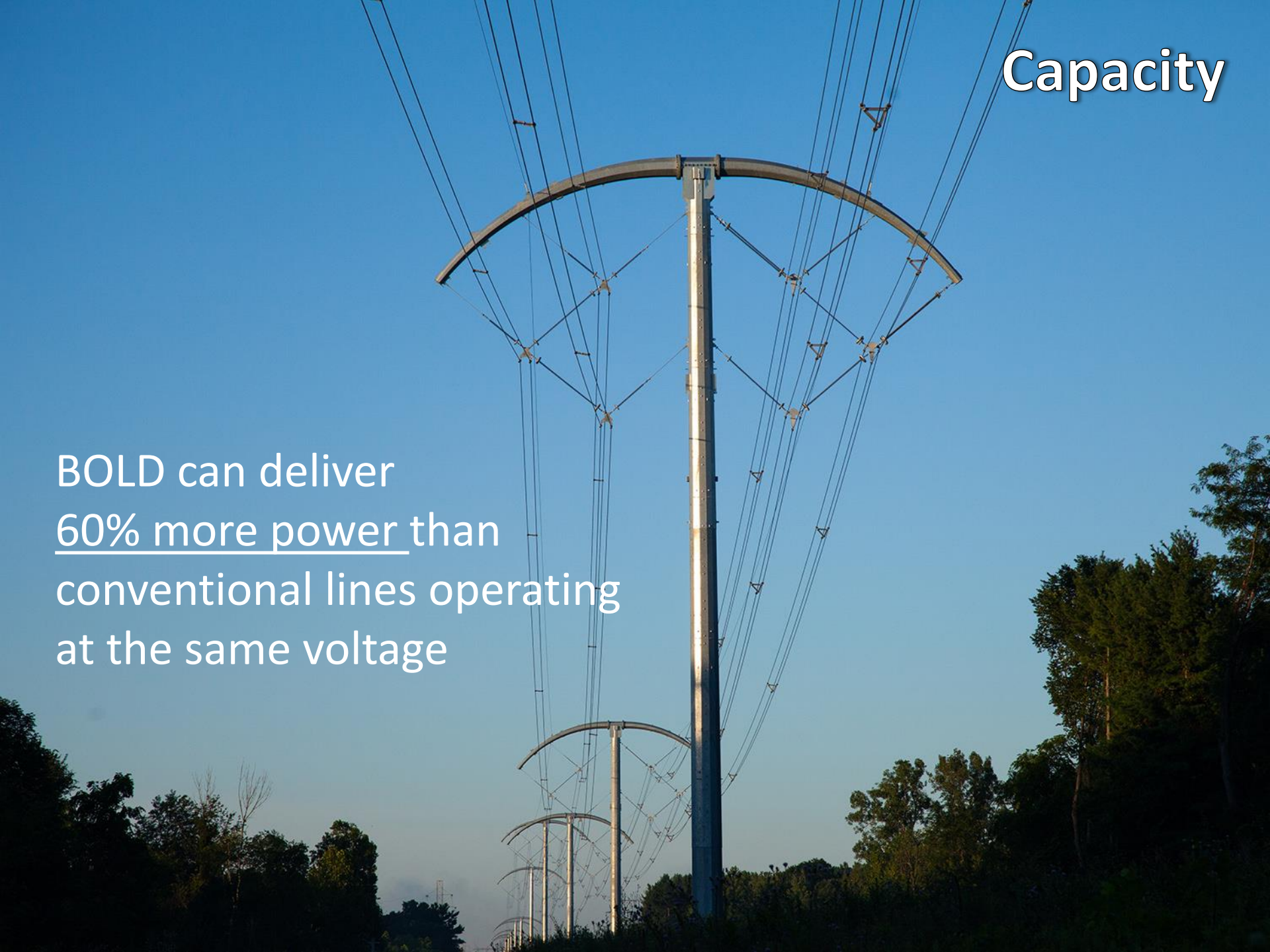
Optimization of  
individual conductors





# Capacity

BOLD can deliver  
60% more power than  
conventional lines operating  
at the same voltage



# Efficiency

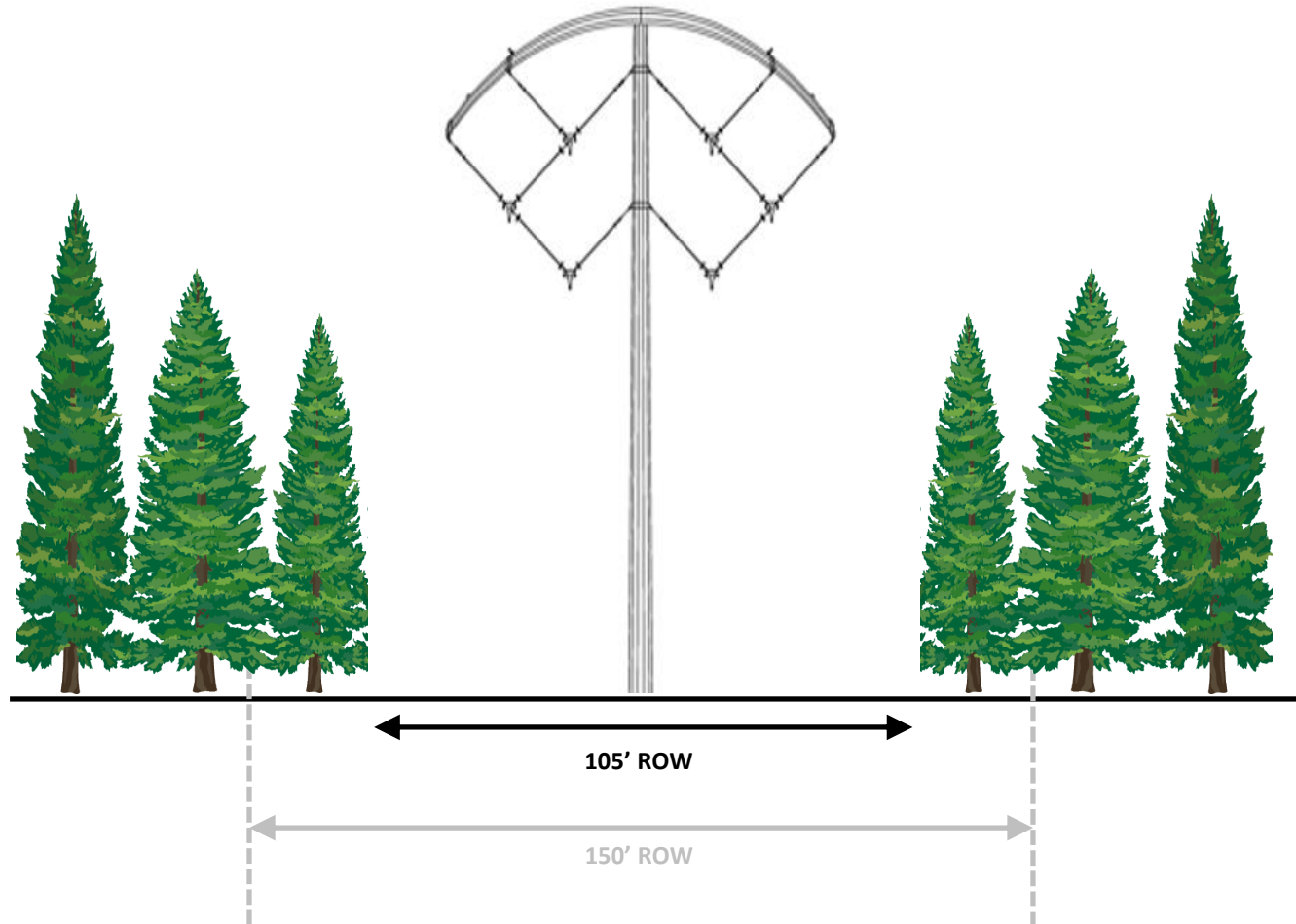


Line loss reduced by up to  
33% over conventional lines



# Better Use of ROW

**BOLD** vs. Traditional 345 kV





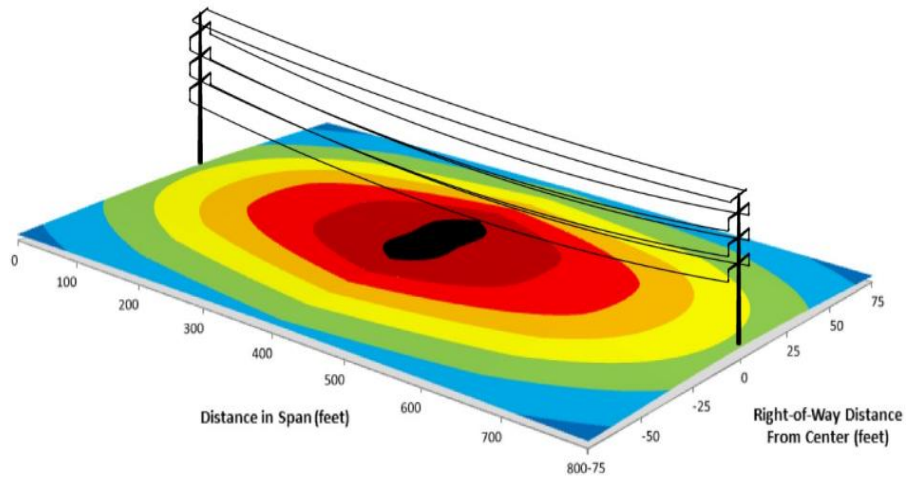
# Better Use of ROW



# Magnetic Field Profile

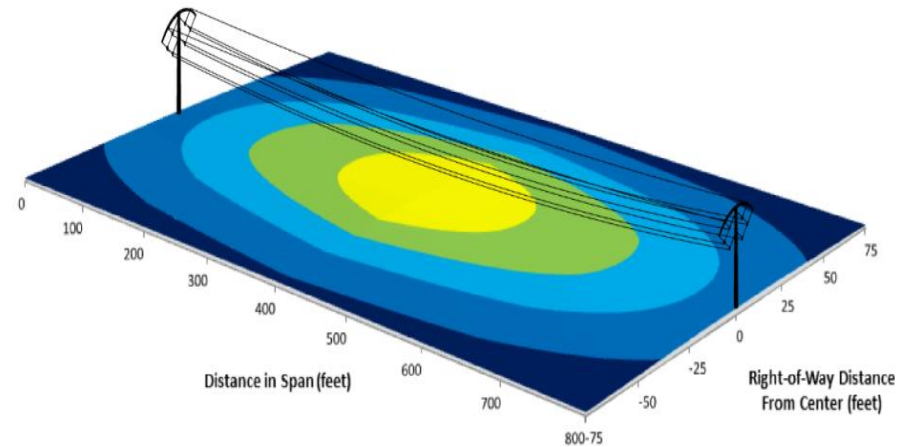
## Conventional 345kV

Magnetic Field Profile @ 1000 MVA Per Circuit  
Conventional 345 kV 2-Cardinal 18" Bundle  
Super Bundle Arrangement (A-B-C / A-B-C)



## BOLD 345kV

Magnetic Field Profile @ 1000 MVA Per Circuit  
BOLD 345 kV 3-Cardinal 15' Phase Spacing 29" Bundle  
Super Bundle Arrangement (A-B-C / A-B-C)



**Magnetic Field Intensity (mG)**

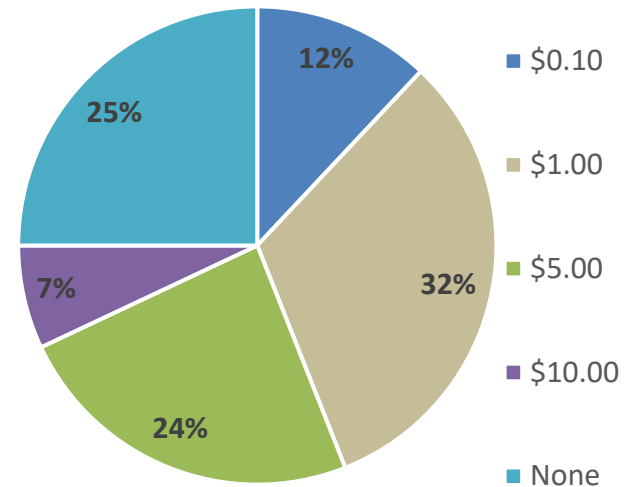
0-30	30-60	60-90	90-120	120-150	150-180	180-210	210-240	240-270	270-300
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# Survey

Community concerns over transmission lines include property value, health impacts, visual impacts

- 79% value advanced technology
- 75% would pay more for advanced technology
- 70% preferred BOLD structures versus conventional double-circuit design

Acceptable monthly premium for advanced technology:

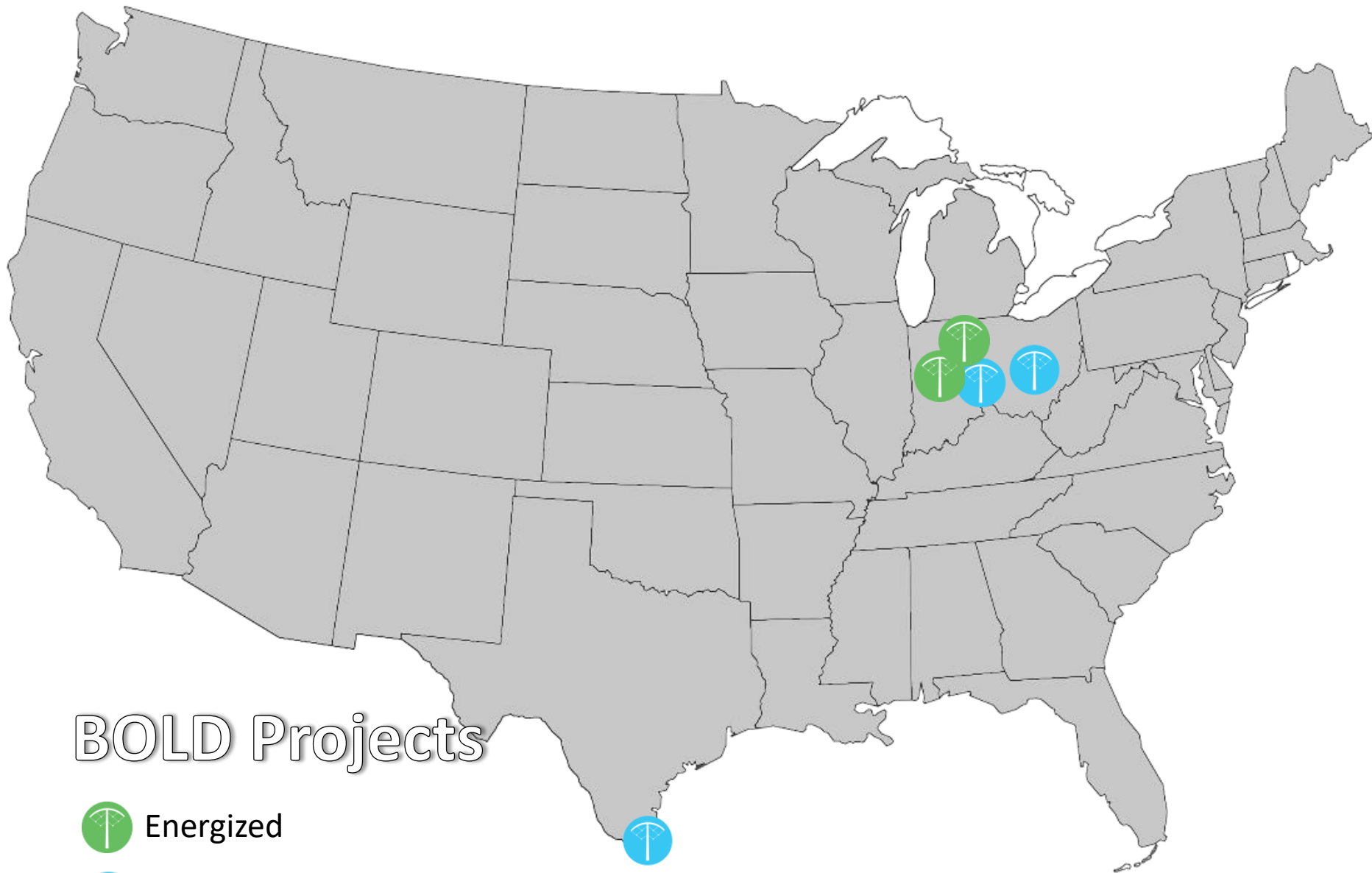


# Faster Deployment

Community acceptance promotes  
faster project siting and completion







# BOLD Projects



Energized



In planning or construction



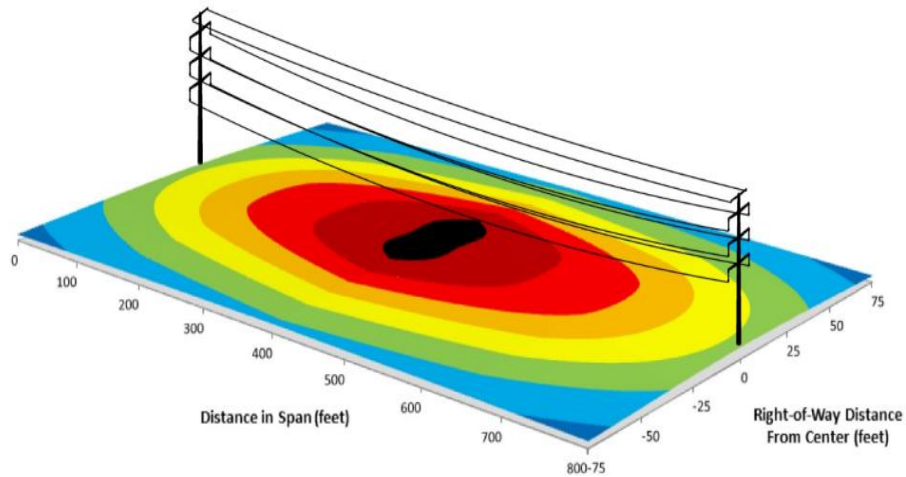
Consider.

**Learn more:**  
**[BOLDTransmission.com/NARUC/](https://BOLDTransmission.com/NARUC/)**

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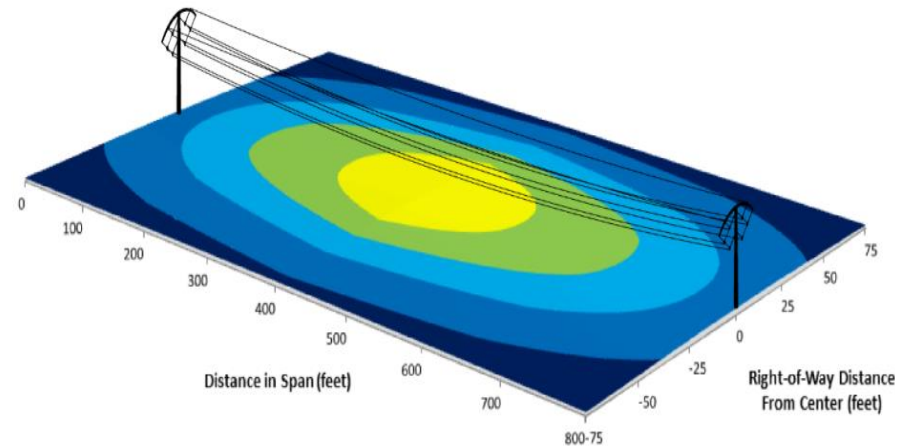
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## Customer Installation Examples



[https://www.youtube.com](https://www.youtube.com/channel/UCydroBm5gkMEJNpStRtHQ6g)  
[/channel/UCydroBm5gkM](https://www.youtube.com/channel/UCydroBm5gkMEJNpStRtHQ6g)  
[EJNpStRtHQ6g](https://www.youtube.com/channel/UCydroBm5gkMEJNpStRtHQ6g)

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