SMART VEGETATION MANAGEMENT: NEW APPROACHES TO AN AGE-OLD PROBLEM

NARUC CENTER FOR PARTNERSHIPS & INNOVATION WEBINAR SERIES

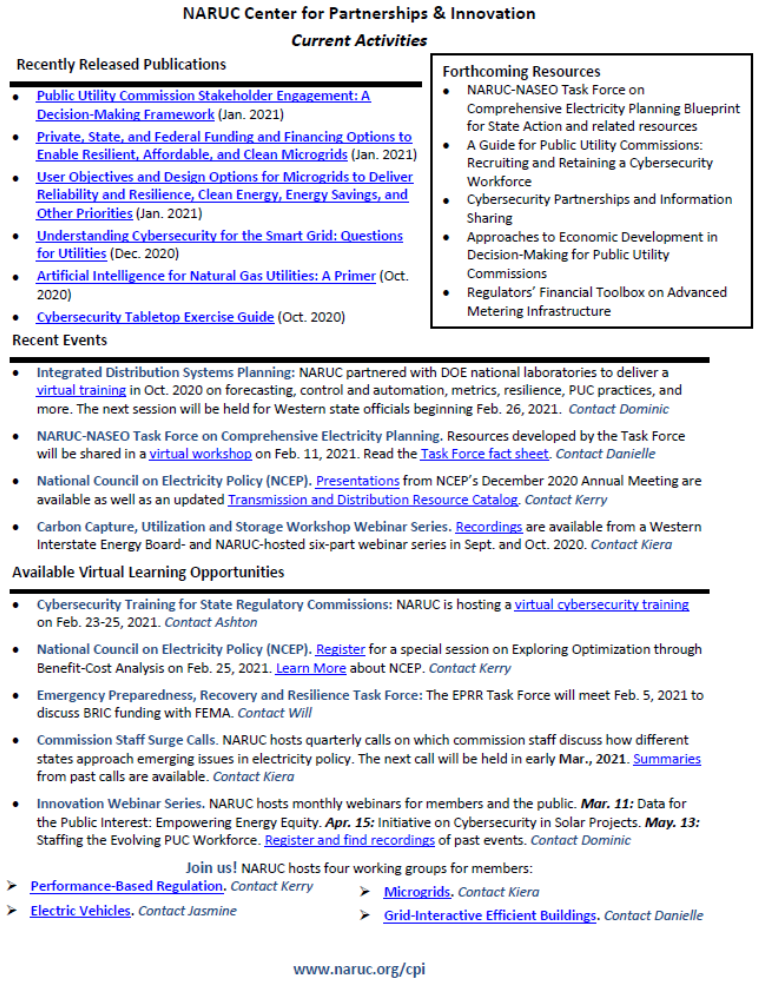
DECEMBER 16, 2021

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.

ABOUT NARUC'S CENTER FOR PARTNERSHIPS & INNOVATION

- Grant-funded team 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.



NARUC Center for Partnerships & Innovation

Current Activities

Recently Released Publications

- Public Utility Commission Stakeholder Engagement: A Decision-Making Framework (Jan. 2021)
- Private, State, and Federal Funding and Financing Options to Enable Resilient, Affordable, and Clean Microgrids (Jan. 2021)
- User Objectives and Design Options for Microgrids to Deliver Reliability and Resilience, Clean Energy, Energy Savings, and Other Priorities (Jan. 2021)
- Understanding Cybersecurity for the Smart Grid: Questions for Utilities (Dec. 2020)
- Artificial Intelligence for Natural Gas Utilities: A Primer (Oct. 2020)
- Cybersecurity Tabletop Exercise Guide (Oct. 2020)

Forthcoming Resources

- NARUC-NASEO Task Force on Comprehensive Electricity Planning Blueprint for State Action and related resources
- A Guide for Public Utility Commissions: Recruiting and Retaining a Cybersecurity Workforce
- Cybersecurity Partnerships and Information Sharing
- Approaches to Economic Development in Decision-Making for Public Utility Commissions
- Regulators' Financial Toolbox on Advanced Metering Infrastructure

Recent Events

- **Integrated Distribution Systems Planning:** NARUC partnered with DOE national laboratories to deliver a virtual training in Oct. 2020 on forecasting, control and automation, metrics, resilience, PUC practices, and more. The next session will be held for Western state officials beginning Feb. 26, 2021. *Contact Dominic*
- **NARUC-NASEO Task Force on Comprehensive Electricity Planning.** Resources developed by the Task Force will be shared in a virtual workshop on Feb. 11, 2021. Read the Task Force fact sheet. *Contact Danielle*
- **National Council on Electricity Policy (NCEP).** Presentations from NCEP's December 2020 Annual Meeting are available as well as an updated Transmission and Distribution Resource Catalog. *Contact Kerry*
- **Carbon Capture, Utilization and Storage Workshop Webinar Series.** Recordings are available from a Western Interstate Energy Board- and NARUC-hosted six-part webinar series in Sept. and Oct. 2020. *Contact Kiera*

Available Virtual Learning Opportunities

- **Cybersecurity Training for State Regulatory Commissions:** NARUC is hosting a virtual cybersecurity training on Feb. 23-25, 2021. *Contact Ashton*
- **National Council on Electricity Policy (NCEP).** Register for a special session on Exploring Optimization through Benefit-Cost Analysis on Feb. 25, 2021. Learn More about NCEP. *Contact Kerry*
- **Emergency Preparedness, Recovery and Resilience Task Force:** The EPRR Task Force will meet Feb. 5, 2021 to discuss BRIC funding with FEMA. *Contact Will*
- **Commission Staff Surge Calls.** NARUC hosts quarterly calls on which commission staff discuss how different states approach emerging issues in electricity policy. The next call will be held in early **Mar., 2021**. Summaries from past calls are available. *Contact Kiera*
- **Innovation Webinar Series.** NARUC hosts monthly webinars for members and the public. ***Mar. 11:*** Data for the Public Interest: Empowering Energy Equity. ***Apr. 15:*** Initiative on Cybersecurity in Solar Projects. ***May. 13:*** Staffing the Evolving PUC Workforce. Register and find recordings of past events. *Contact Dominic*

Join us! NARUC hosts four working groups for members:

- Performance-Based Regulation. *Contact Kerry*
- Electric Vehicles. *Contact Jasmine*
- Microgrids. *Contact Kiera*
- Grid-Interactive Efficient Buildings. *Contact Danielle*

www.naruc.org/cpi

Regularly updated CPI fact sheet with recent publications & upcoming events under Quick Links at:

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

MODERATOR

DAN SCRIPPS, CHAIR, MICHIGAN PUBLIC SERVICE COMMISSION

PANELISTS

RYAN YANEK, MANAGER OF DISTRIBUTION PLANNING AND ASSET MANAGEMENT, PPL ELECTRIC UTILITIES

BRADLEY SMITH, VICE PRESIDENT, AIDASH

DR. ASHLEY BENNETT, ENVIRONMENTAL RESEARCH SCIENTIST, ELECTRIC POWER RESEARCH INSTITUTE

Vegetation Management

Ryan Yanek
Manager- Distribution Planning & Asset Management
December 16, 2021

PPL Electric Utilities

What is Utility Vegetation Management?

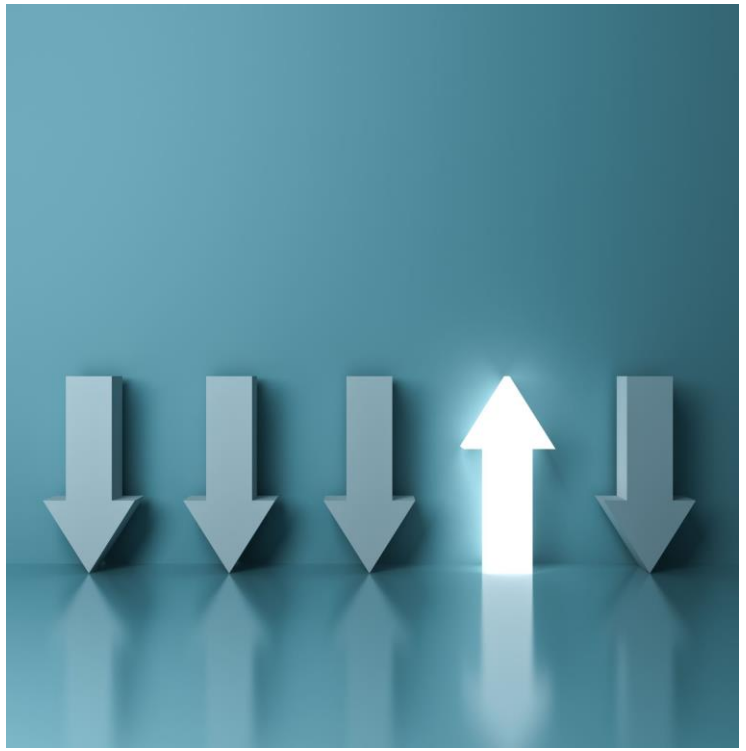
- A program to improve reliability by reducing tree-related outages

- Trimming and removing the right trees and brush at the right time to prevent outages and maintain the safety and reliability of the distribution system

PPL Electric Utilities

Challenges

- Financial
- Environmental
- Operational
- Impact to Customer Satisfaction



PPL Electric Utilities: At a Glance

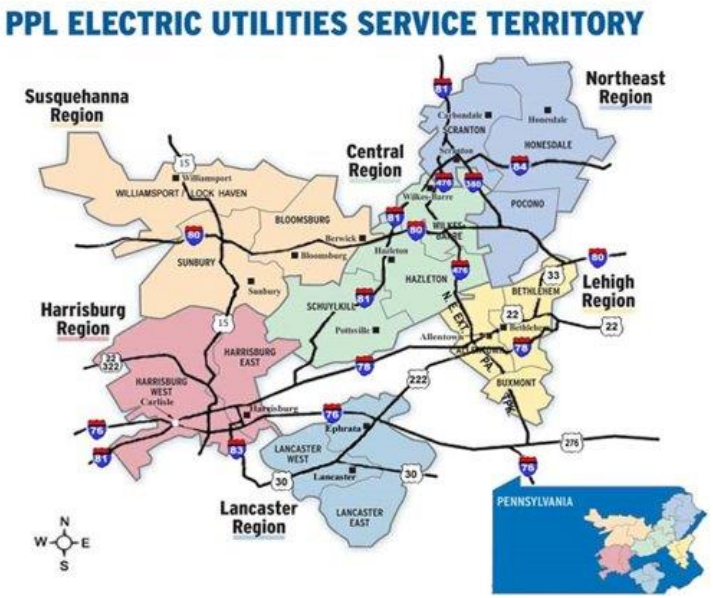
One of the nation's most innovative and trusted utilities

- 1.4 million customers across 29 counties in Pennsylvania

- 50,000 miles of power lines

- AEIC Achievement Award for Revolutionizing Vegetation Management

- Winner of 30 J.D. Power awards for customer satisfaction



PPL Electric Utilities

Our Vegetation Management Program

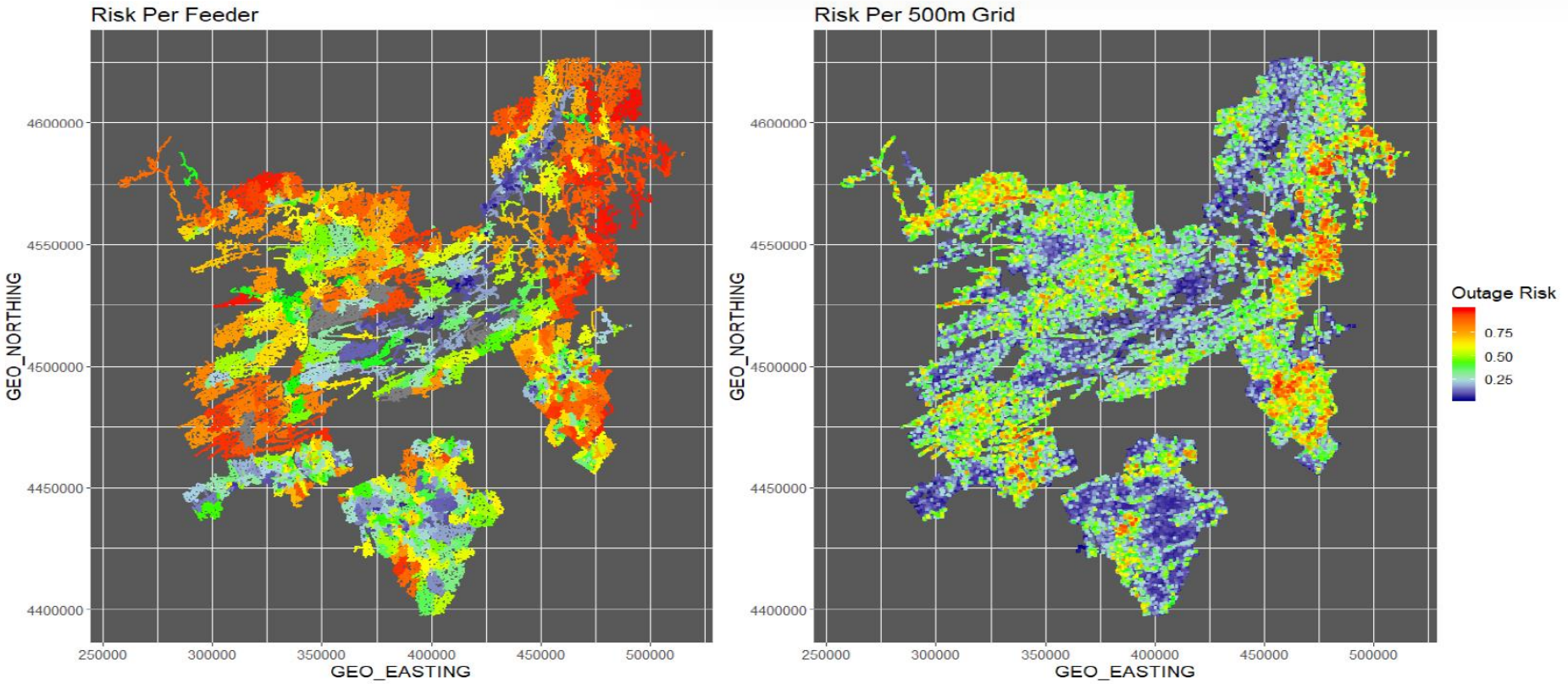
PPL Electric Utilities

Program Enhancements

- Implemented LiDAR technology in 2010
- Reclaimed transmission Right of Way between 2010 – 2016
- Enhanced distribution tree-trimming between 2013 – 2018
- Initiated 3rd party pre-planning to be selective in Maintenance scope
- Established unit-based contracts
- Implemented new software
- Established risk-based scope prioritization
- Implemented data analytics model to guide program

Program Evolution

Cadence Feeder | Grid Span Tree



PPL Electric Utilities

Integrating Analytics

- Risk/Reliability circuit prioritization: 2019

- Risk/Reliability within circuits: 2020
  - High-risk and high vegetation risk scores
  - PH-1 targeted high-risk grids (500m x 500m)
  - PH-2 risk guided linear maintenance

- Risk/Reliability within circuits: 2021
  - All circuits use PH-2 risk guided linear maintenance
  - Positive results of grid pilot led to additional scope

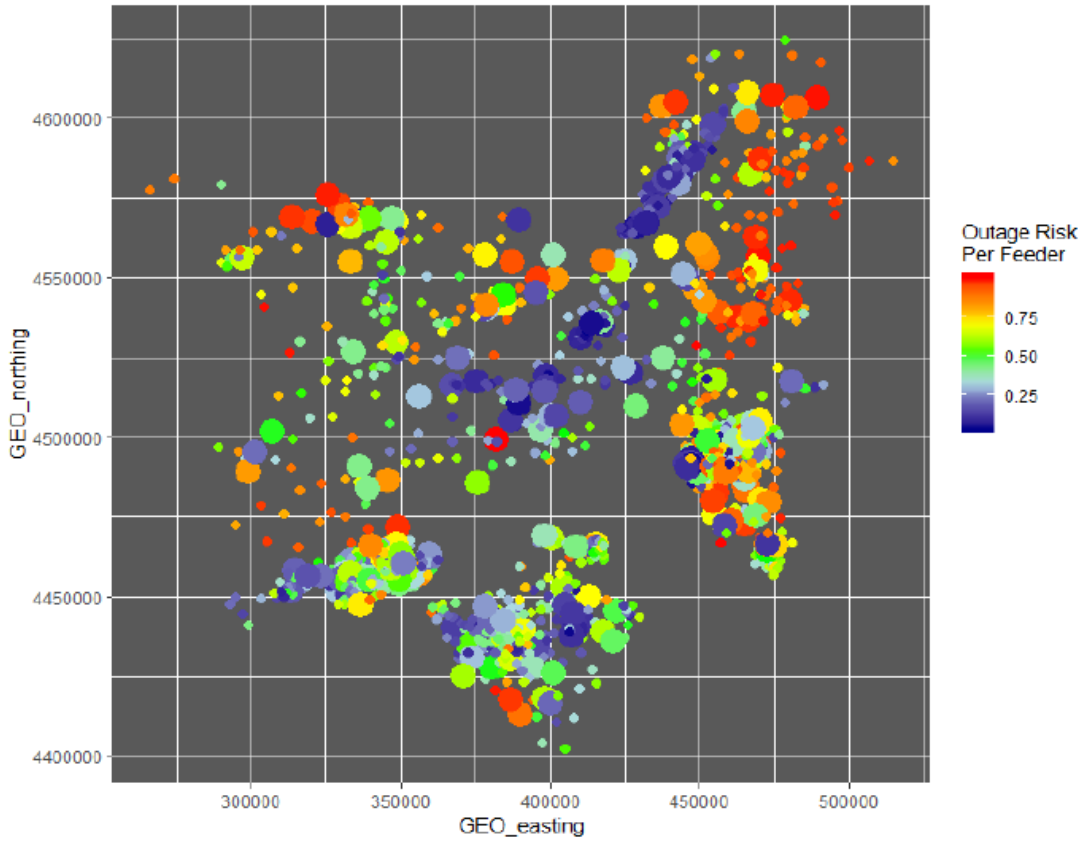
PPL Electric Utilities

The Result: Improved Reliability

- Improved vegetation SAIFI by 14% in 2020 compared to 2019, without increasing budget

- Increased accountability

- More accurate forecasting for future work



PPL Electric Utilities

Questions?

PPL Electric Utilities

Smart Vegetation Management: New Approaches to an Age-Old Problem.

Presented By

Bradley Smith
VP, Sales Operations &
Demand Generation

AIDASH

AiDash: Overview

About

Incorporated:
Jan 29, 2019

Offices:
San Jose CA | Reston VA | Austin TX
Bengaluru IND | London UK

Partners

BCG BOSTON CONSULTING GROUP
esri
UP42
MAXAR
GHGSAT
OGC Making location count.

Metrics

300K+ Miles
Live on **+300,000 T&D Miles.**

Partnering with **40+ Utilities**

Operating in **42 States**

Deployed on **5 continents**

1st Satellite-Powered Veg Mgmt Product **Deployed at Scale**

Investor(s)

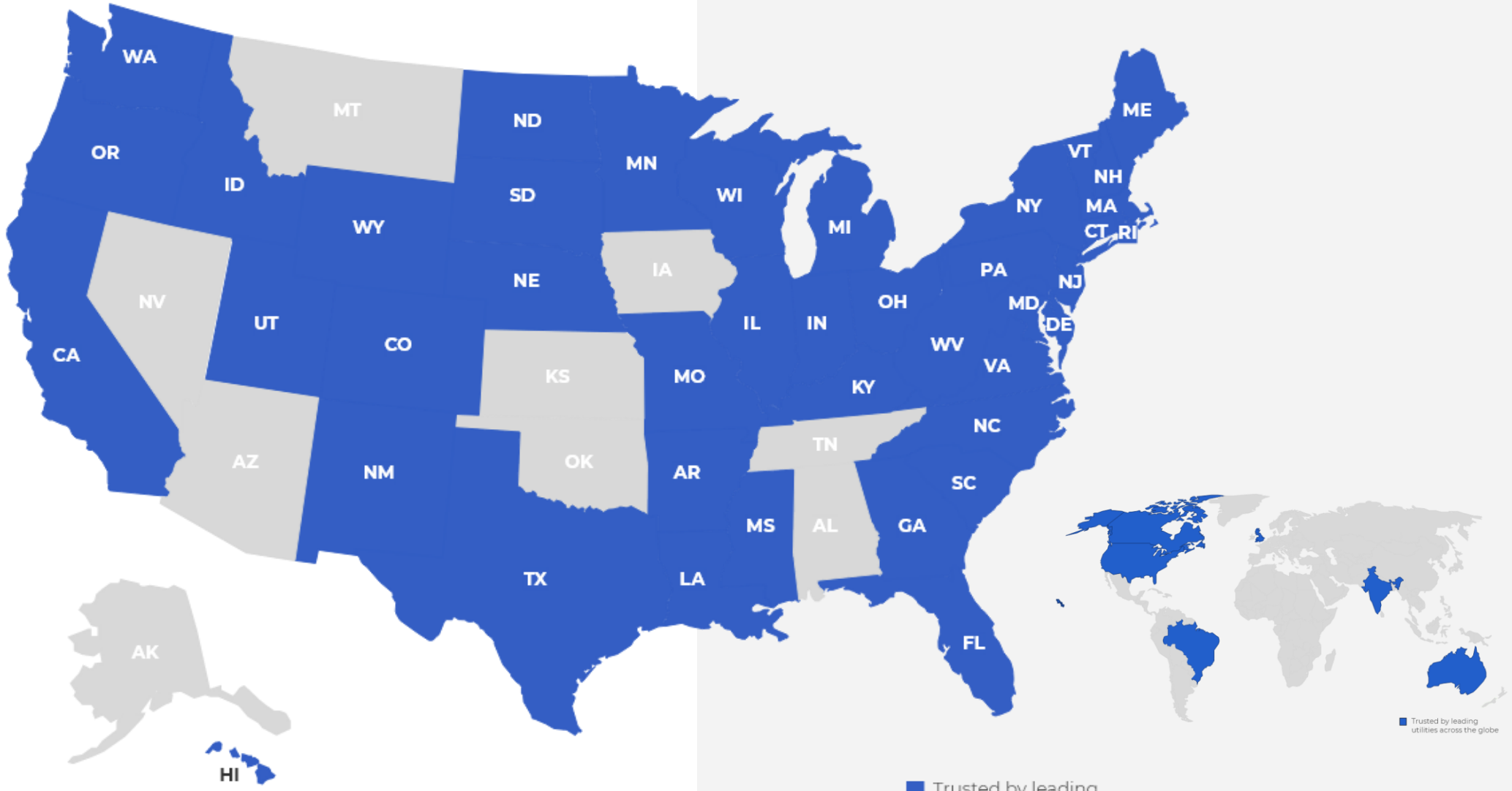
nationalgrid partners
EDISON INTERNATIONAL
G2 VENTURE PARTNERS
BGV BENHAMOU GLOBAL VENTURES

AVISTA

"Using satellite technology allows us to concentrate our planning in the office rather than in the field. Human-based inspections are temporal and costly. Satellite imagery paired with circuit performance gives us a much more accurate picture of vegetation risk and helps us target hotspots and emerging threats. This is a game-changer."

David James
Wildfire Resiliency Plan Manager
Avista

Partnering with Electric Utilities Around the United States & World



01 Vegetation Management Challenges.

Vegetation Management Today.

Manual

Time Intensive

Fixed-Cycle

Dynamic Conditions

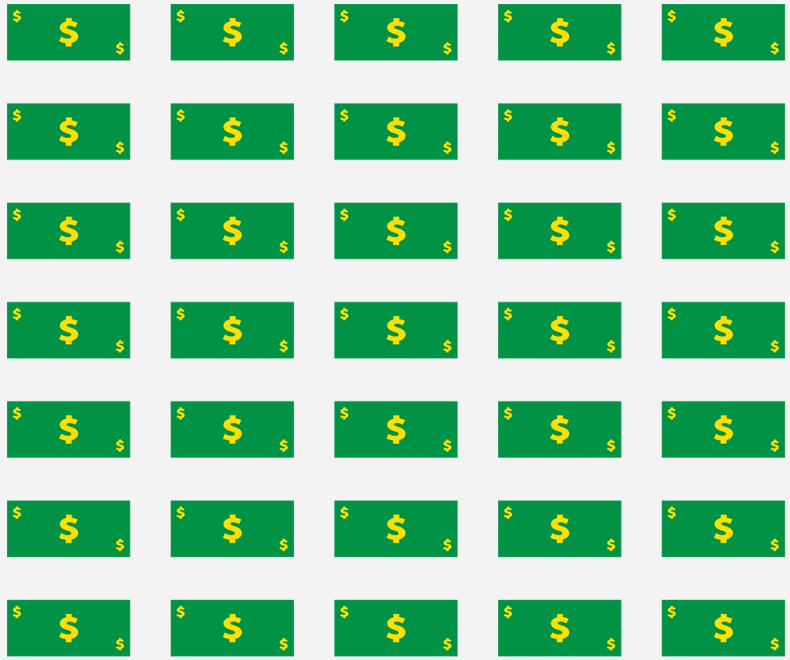
Climate Change

Threat Identification

Permitting & Scheduling

Changes in Land Mass

Rising Costs



$100m

Vegetation management is frequently the single largest line item in annual operating budgets, exceeding $100 million annually in many larger utilities.

- Elizaveta Malashenko, ex-Deputy Executive Director, California Public Utilities Commission

AIDASH

Macro Challenges Increasing Wildfire Risk

Climate Change

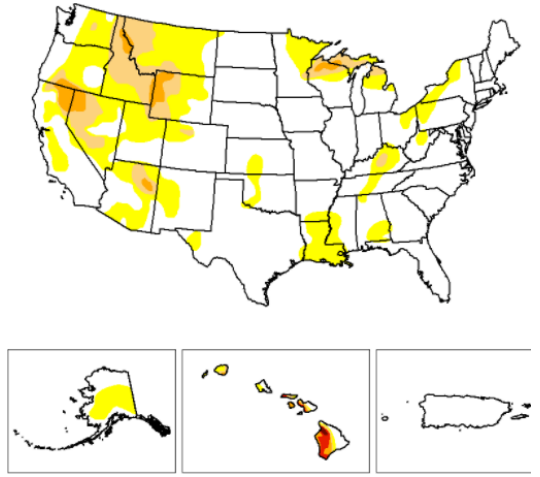
High fuel density & low moisture

Rise in population in HTFD areas

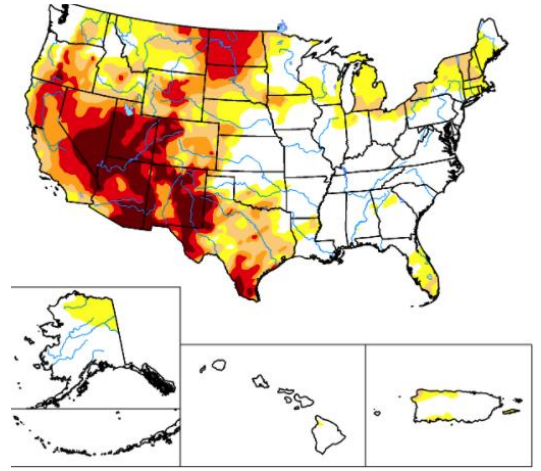
Expanding utility infrastructure in rural/ WUI areas

Increases in invasive species like bark beetles

Intensifying Veg Management Challenges



April 13, 2010 Drought Map



April 13, 2021 Drought Map

Source: [14]

Measuring the Impact

> Powerline fires are on average 10X larger than fires from other causes.
> -
> California Public Utilities Commission

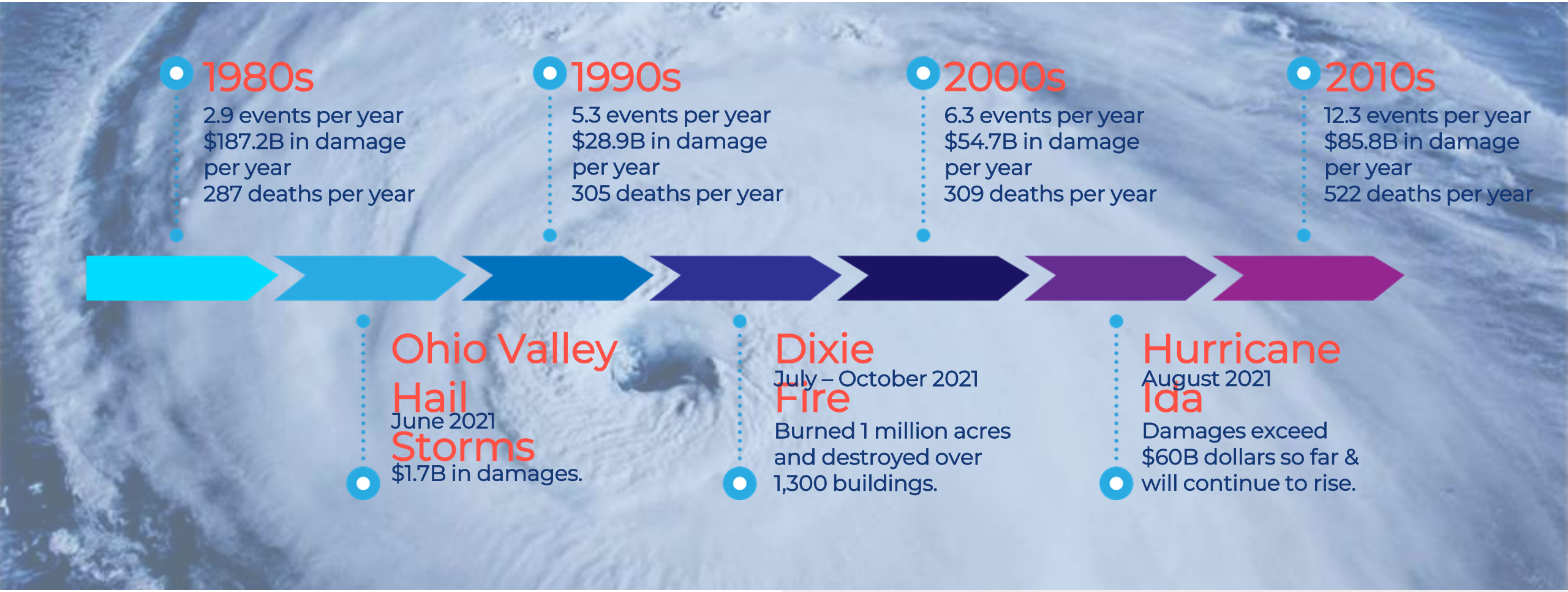
Human Impact

Buildings Destroyed

Acreage Burned

Financial Loss

$1 Billion Disaster Events: Weather & climate disasters are increasing in frequency.



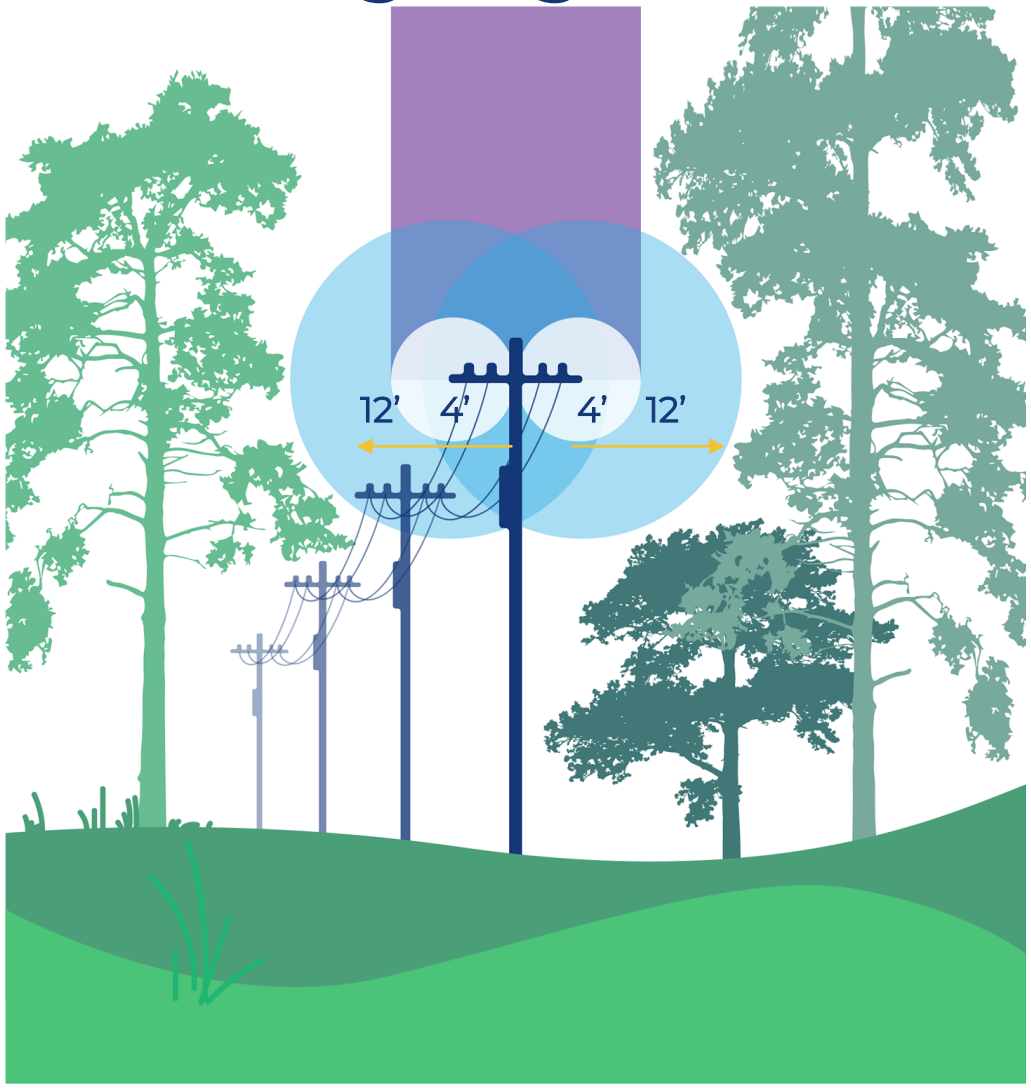
2021 so far: January – September.

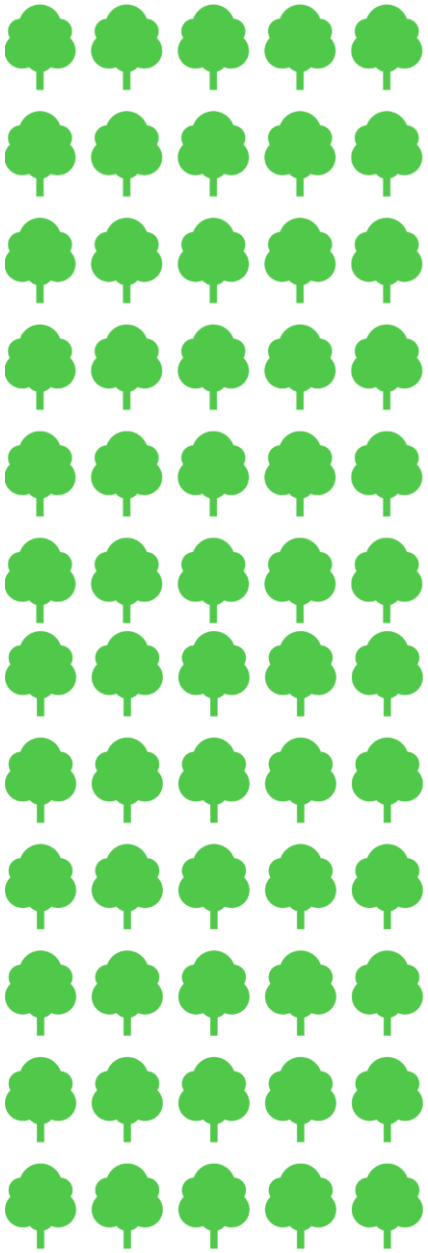
- 18 events
- $104.8B in damage

AIDASH

02 Satellite & AI Technology Enabling Smarter Veg Management.

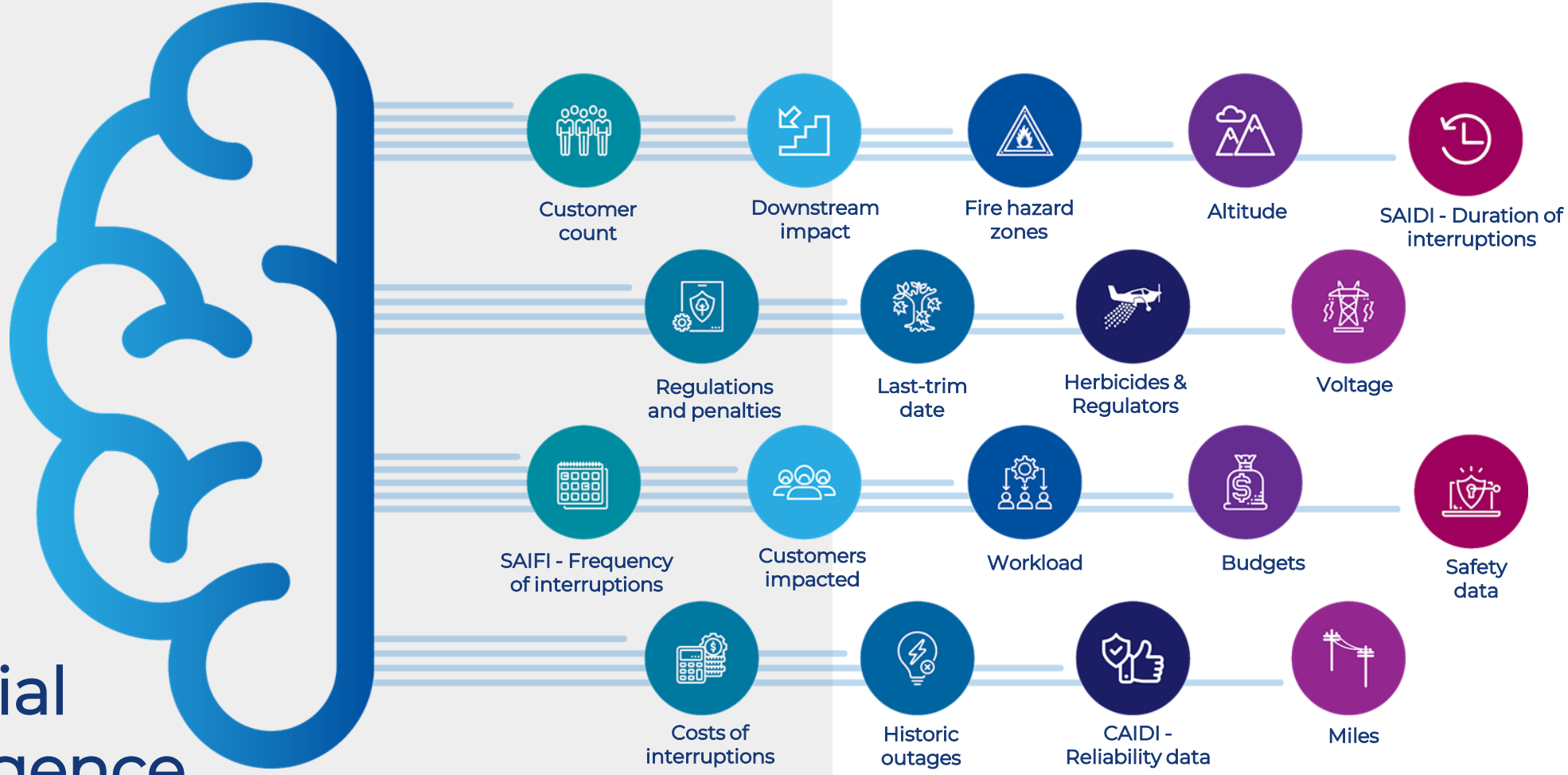
What's possible with satellite based veg mgmt.





- Clearance Classification for each span (identifying All Danger Trees outside ROW, & fuel load
- Ability to accurately measure tree health, predict growth and clearance from lines
- Cost- Effective Frequent Inspections All lines
- Allocate O&M budget most wisely to improve reliability the most.
- Improve Efficiency by automating and reducing IVM

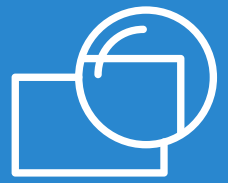
Fuse Vegetation, Environmental, and Enterprise Data with Business Logic.



Artificial Intelligence

AIDASH

This wasn't possible before due to...



Resolution & Spectrum

50 years of advancements from 80m resolution to 10cm resolution

Revisit Rates

Today, the combination of all constellations have a revisit rate of ~24 hrs.

Cost

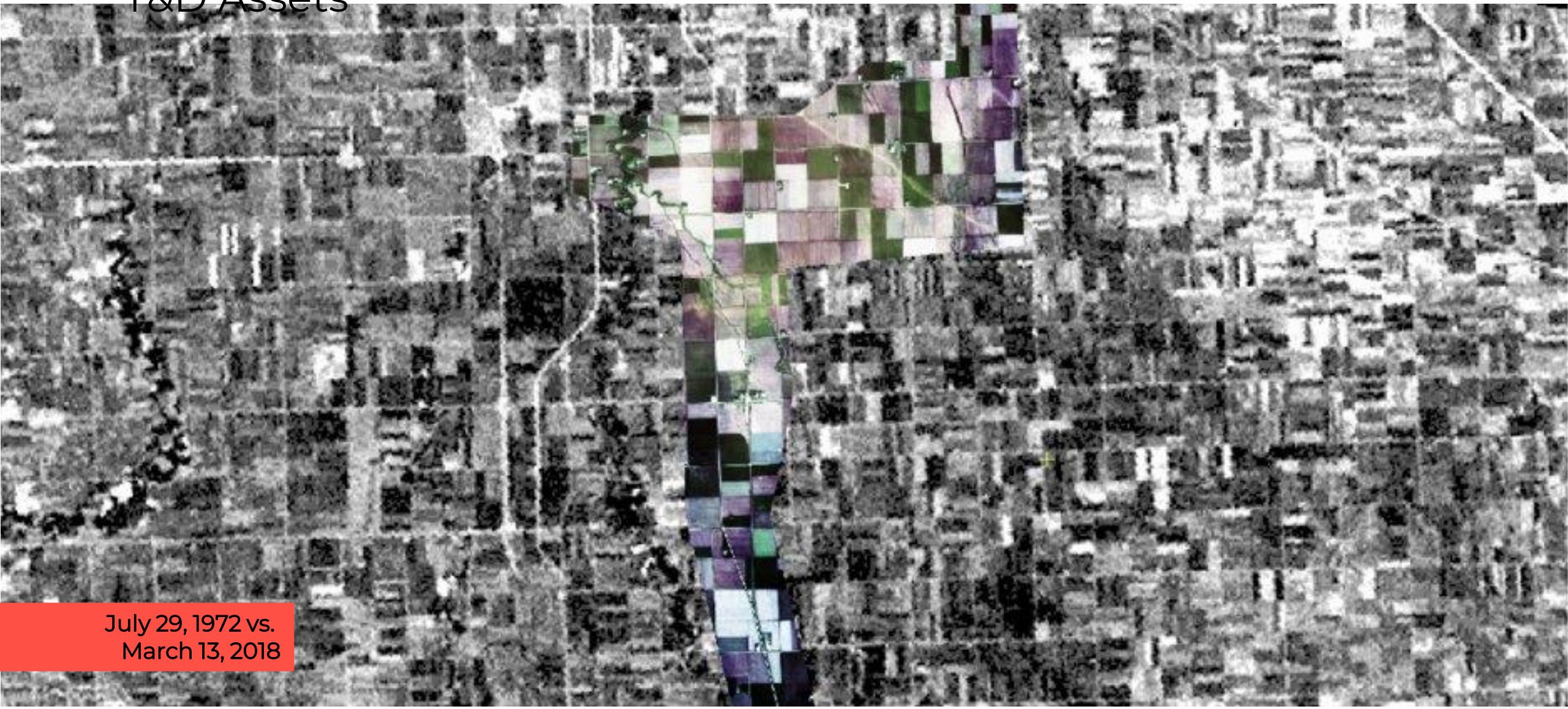
With recent advancements in reusability of rockets. The cost of imagery has decreased dramatically.

Former AI Limitations

In the past serval years, there have been giant leaps forward in both artificial intelligence and image recognition, making this now possible.

AIDASH

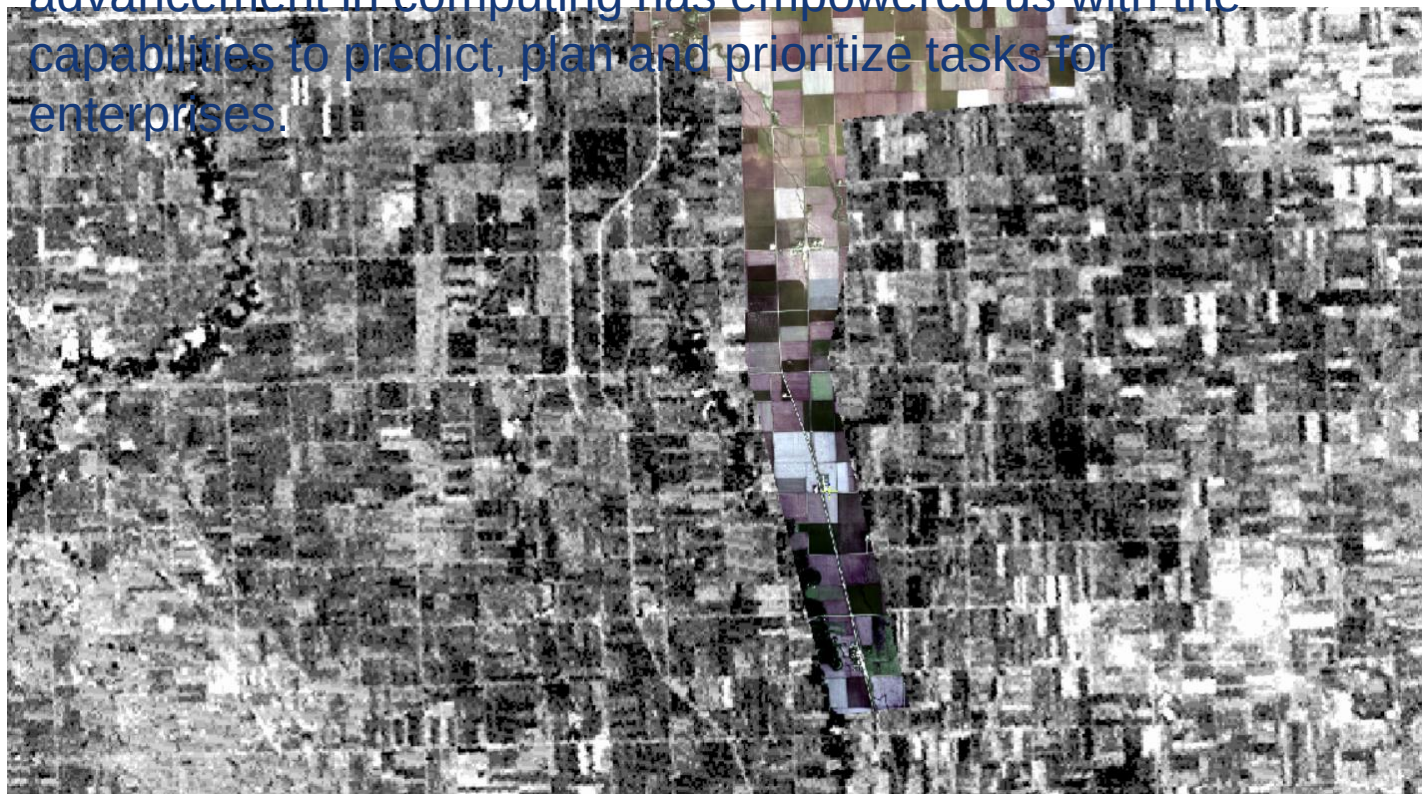
Satellites are Transforming Monitoring & Surveying Capabilities of T&D Assets

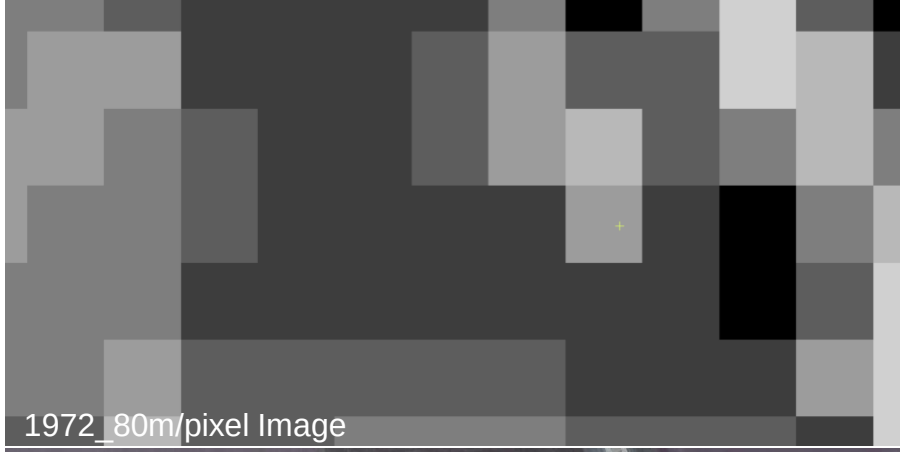


Fargo, North Dakota as seen from Landsat-1 in 1972 and WV 03 in 2018

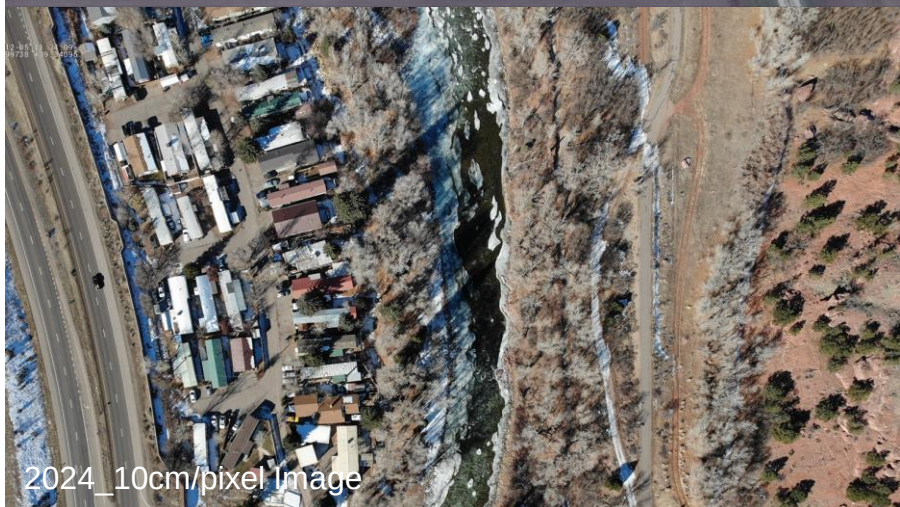
Historical Data Collection and Analyzing the Data is possible via Satellites & AI

Data available from 1970 i.e., for over 50 years **= a generation of data!** But how can we analyze this massive amount of data?
Artificial Intelligence can make it possible. The recent advancement in computing has empowered us with the capabilities to predict, plan and prioritize tasks for enterprises.



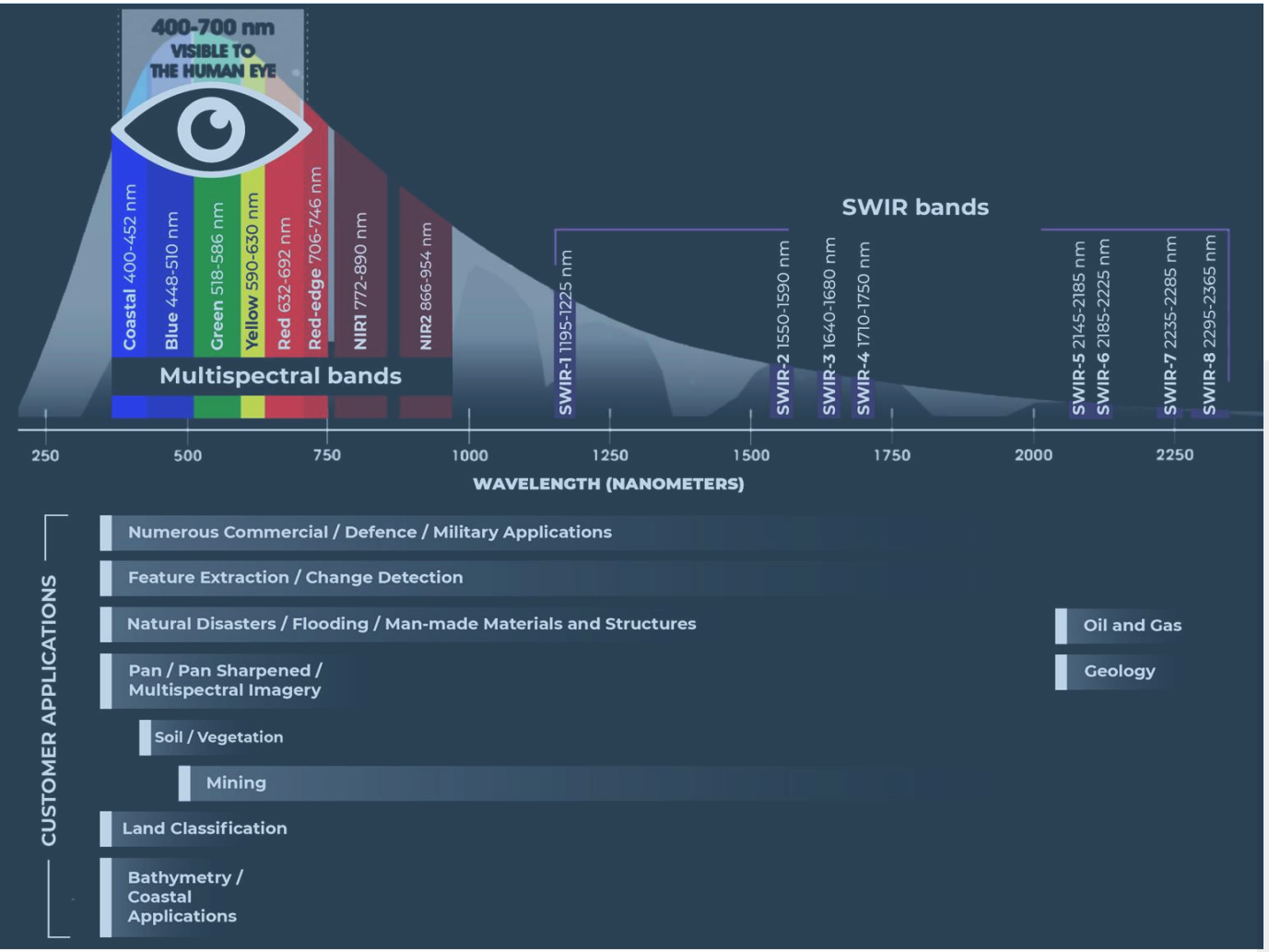

1972_80m/pixel Image


2018_30cm/pixel Image

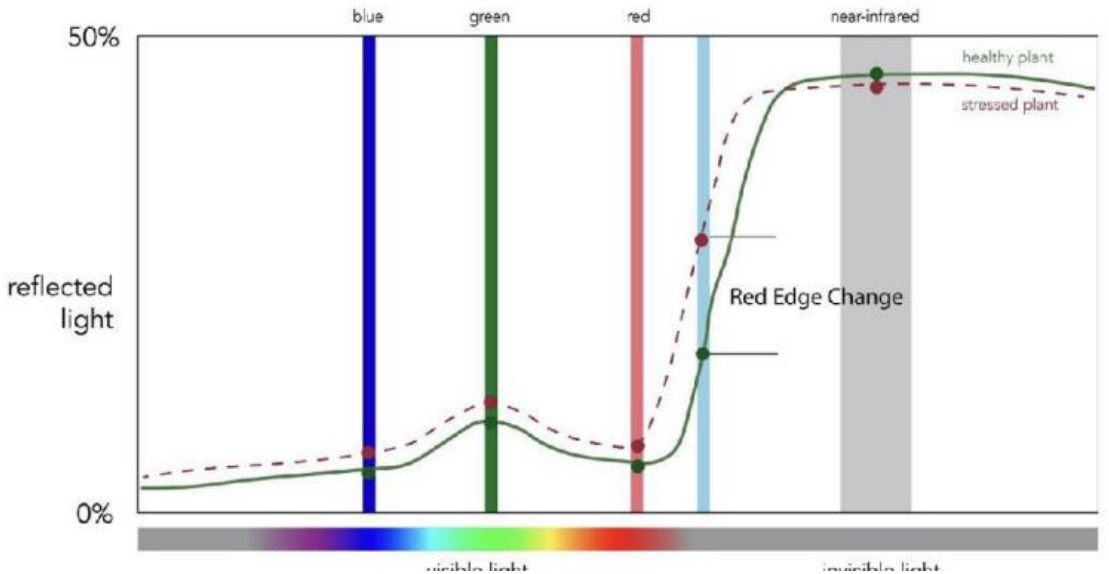

2024_10cm/pixel Image

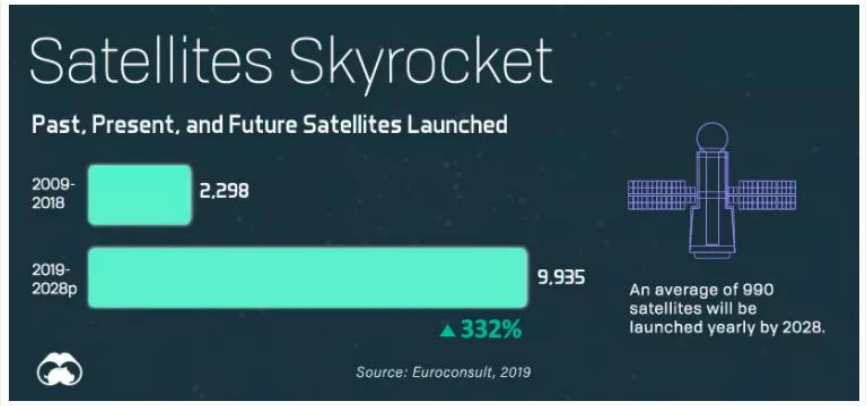
AIDASH

Multispectral bands are opening the gates to new insights



Red Edge Band of Spectrum



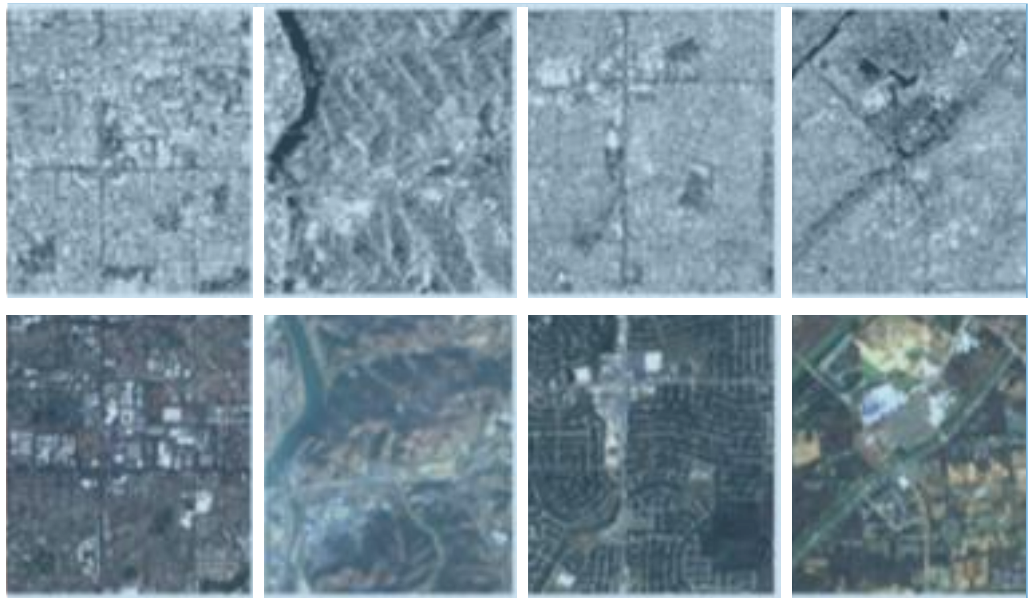


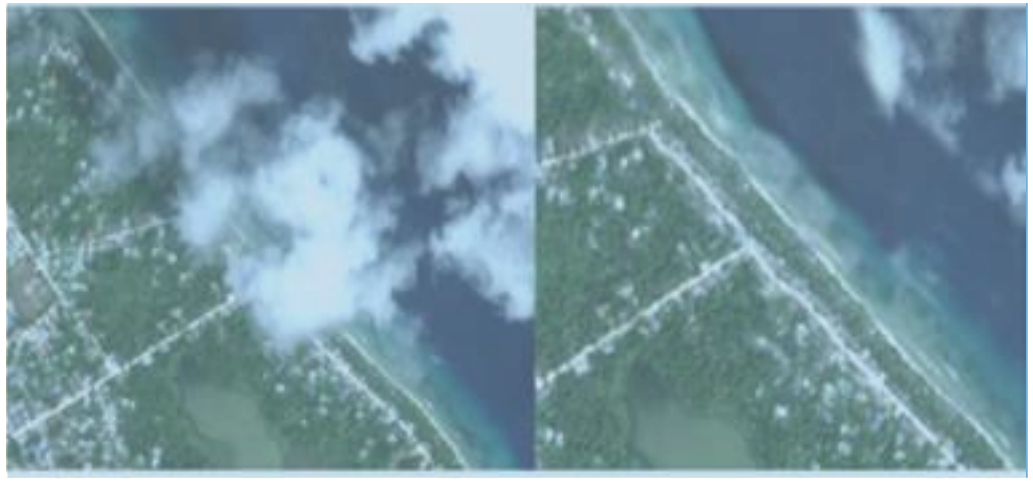
Nearly 10,000 satellites will be launched form 2019-2028. Image: Visual Capitalist

Daily scans available for every point on earth. Hourly scans to be possible soon.
12-inch resolution imagery available today. 4-inch resolution to be available soon.

- Hyper-spectral and Infrared bands coming soon.
- SAR imagery available to see through clouds and night.

About Synthetic Aperture Radar Technology.

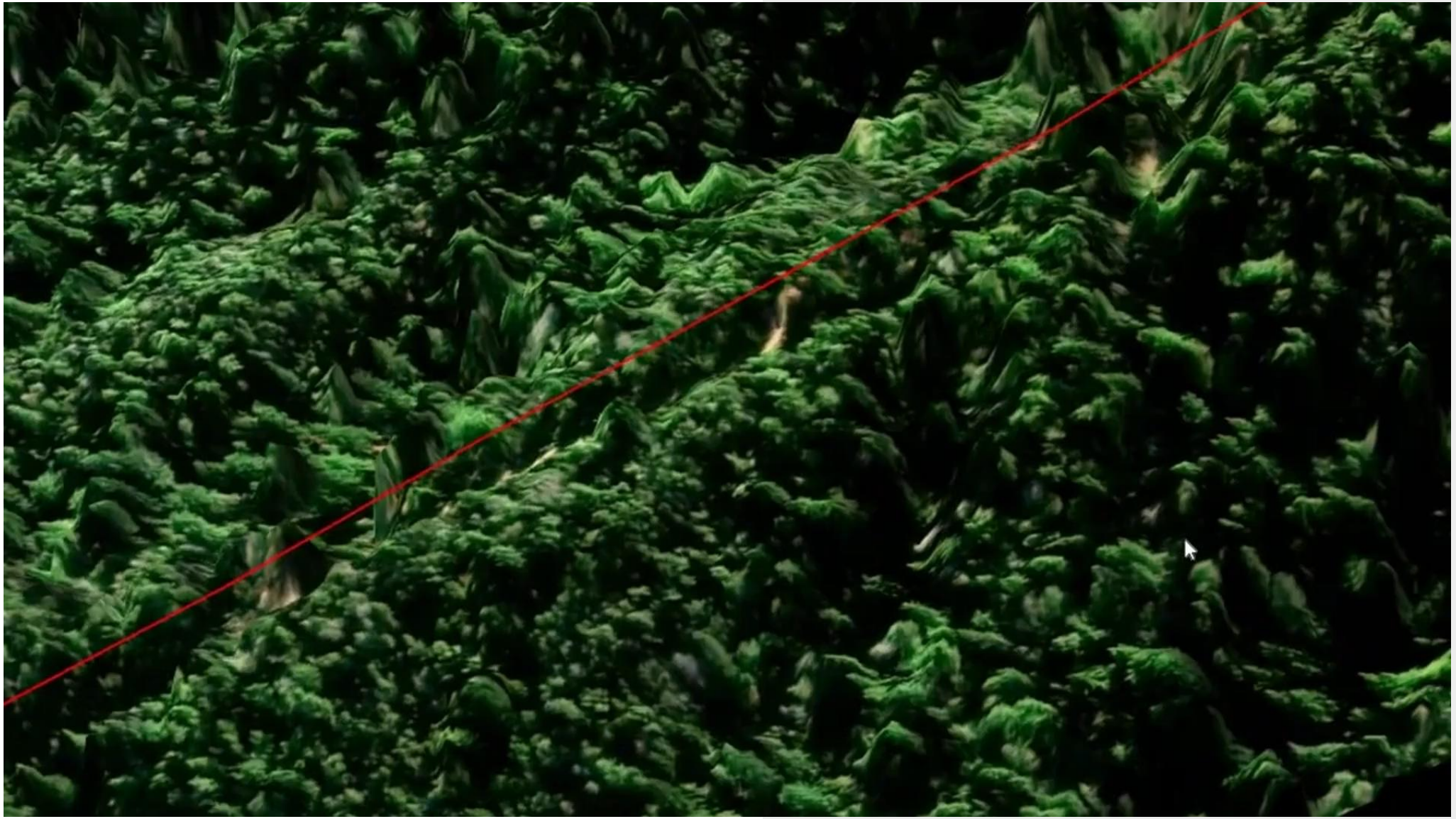




Band	Frequency	Wavelength	Typical Application
X	8-12 GHz	3.8 - 2.4 cm	High-resolution SAR (urban monitoring; ice and snow, little penetration into vegetation cover; fast coherence decay in vegetated areas)
C	4-8 GHz	7.5 - 3.8 cm	SAR Workhorse (global mapping, change detection; monitoring of areas with low to moderate penetration; higher coherence) ice, ocean maritime navigation
S	2-4 GHz	15 - 7.5 cm	Little but increasing use of SAR-based Earth observation, agriculture monitoring (NISAR will carry an S-band channel; expends C-band applications to higher vegetation density)
L	1-2 GHz	30 - 15 cm	Medium resolution SAR, geophysical monitoring, biomass and vegetation mapping, high penetration, inSAR)
P	0.3-1 GHz	100 - 30 cm	Biomass. First P-band spaceborne SAR will be launched ~2020; vegetation mapping and assessment. Experimental SAR.

Source: NASA

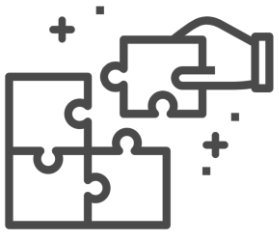
Satellites and Artificial Intelligence in Action



https://youtu.be/LCgjuoEoWzs

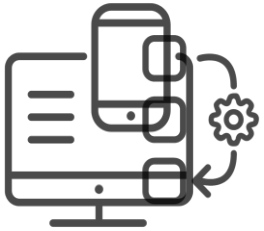
Low Hanging & High Yielding Fruits for Smarter Veg Management.

Up-to-date 360° view of your entire grid



Deep & wide analysis of all encroachments (Tbs of data)

Use AI to demystify complex data to create optimal annual plans



Digitize & Unlock Operational efficiency

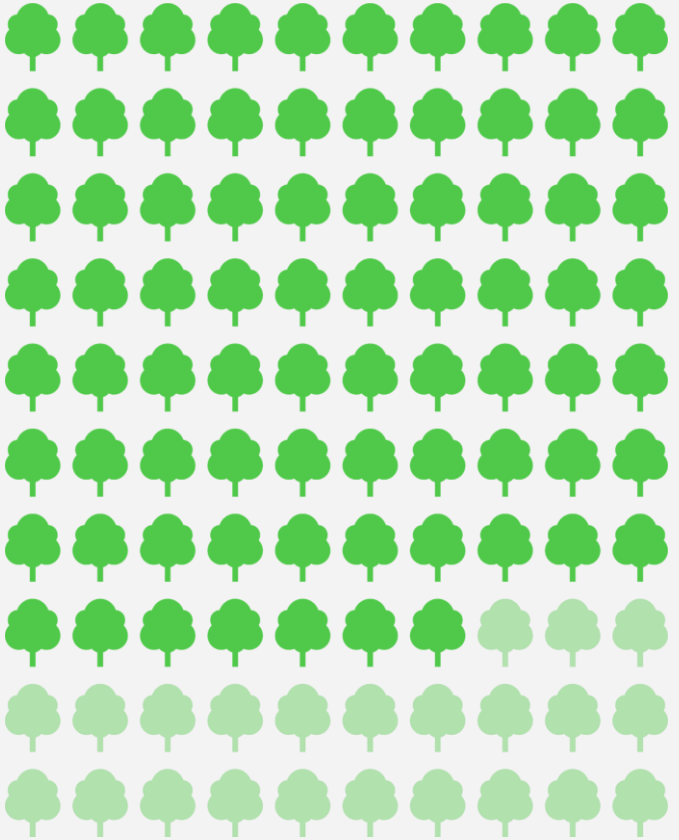
Validate 3rd party contractors with Post-Trim Inspection

Accelerate Disaster Response

77%

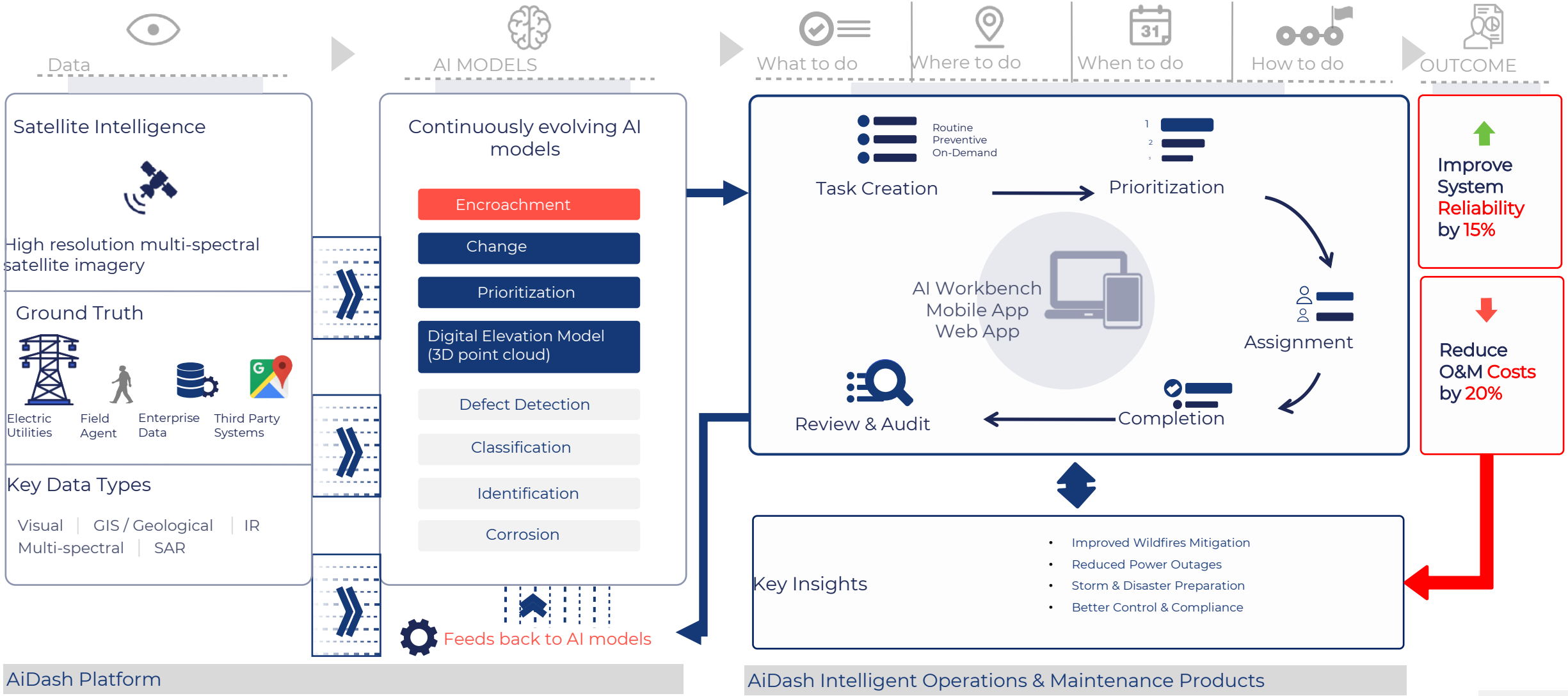
of all utility arborist work hours were done by outsourced contractors, in 2016.

- Utility Arborist Association



AIDASH

AiDash Platform combined with GeoAI helps Predict, Plan and Prioritize Wildfire Mitigation Tasks



03 Questions.

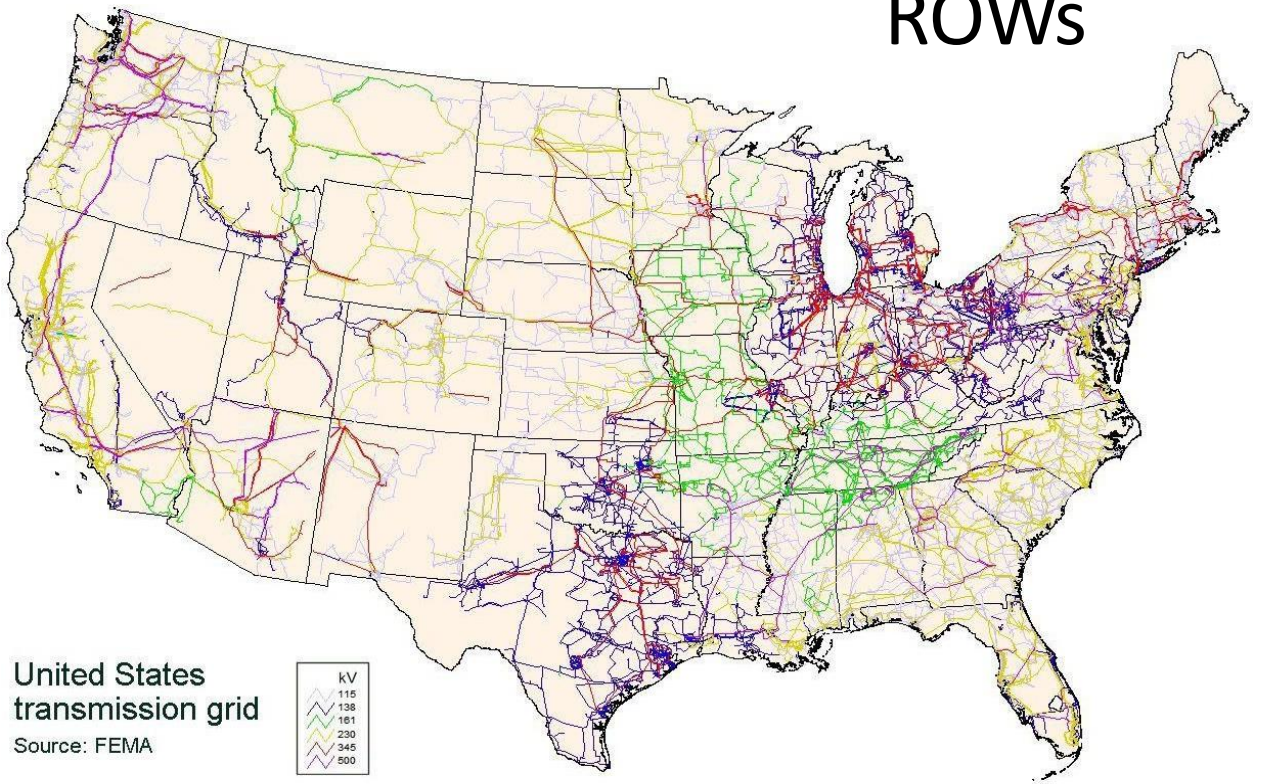
Can native vegetation improve the reliability and sustainability of energy generation?

Dr. A. Bennett, EPRI
December 2021

Vegetation Management Opportunities

- Over 200,000 miles of high-voltage transmission lines
- ROWs account for ~12M acres of open canopy habitat in US
- US projected solar ~10M acres by 2050
- Globally projected solar ~32M acres by 2050
- Cost benefits to land management
- Conservation benefits
  - Pollinators
  - Native Plants
  - Birds
  - Bats
- Opportunity for stakeholder and community engagement

ROWs



- Native vegetation changes by region & site
- Constraints by asset
- Different mixes & management are needed

Photo: A. Bennett

Photo: Allen Cressler

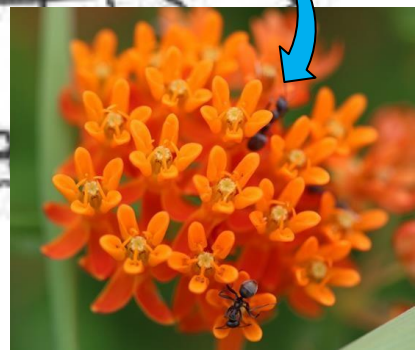


Photo: A. Bennett

Photo: Wes Cunningham, Stantec

Photo: AEP

Why Native Plants….Roots & Structure

GREATER COMPETITION

Lower Maintenance

Biodiversity

Improved Soils

Drought Tolerant

Increased Filtration

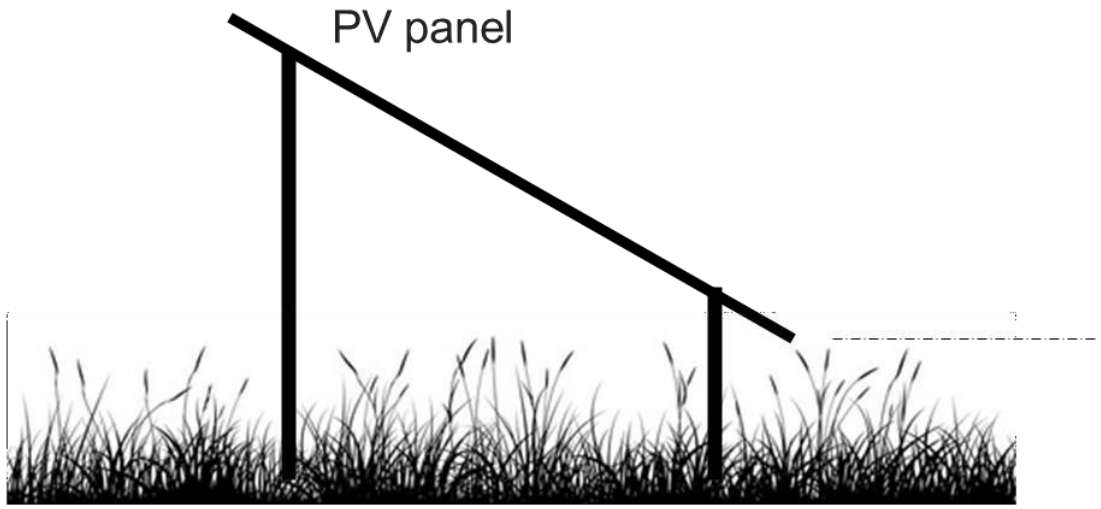
DECREASED Soil Erosion

REDUCED WATER RUNOFF

Evaluating Pollinator Habitat Establishment at Solar
Southern Company, Stantec, EPRI

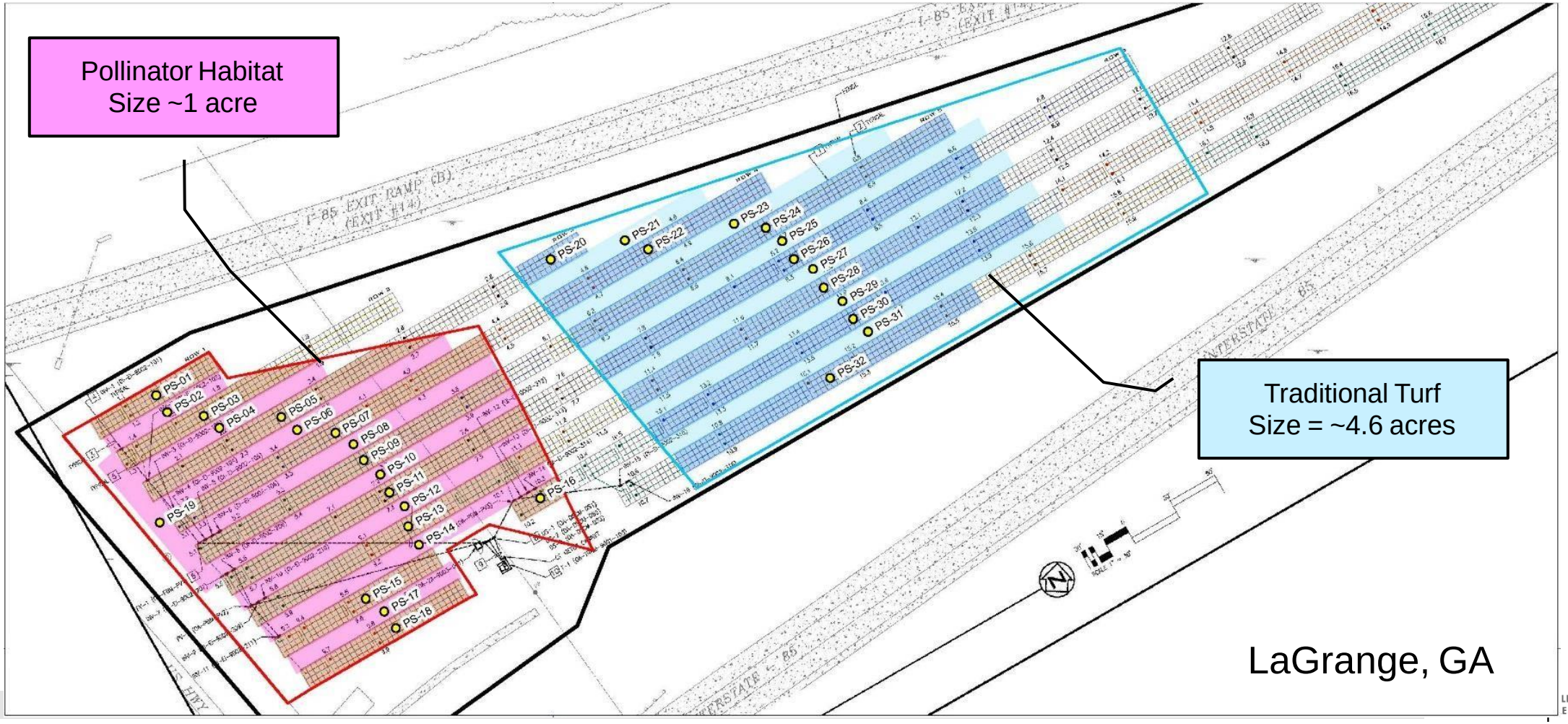
Project Questions

1. Which seed mixes meet establishment requirements?
    - Percent Cover
    - Plant Height – Targeted species with max height of ~18”
2. Will native vegetation increase the abundance and richness of pollinators compared to turf grass?



Vegetation Treatments

- Solar site was divided into 2 demonstration areas
  1. Pollinator Habitat (Pink)
  2. Traditional Turf Habitat (Blue)



Final Seed Mix Specifications

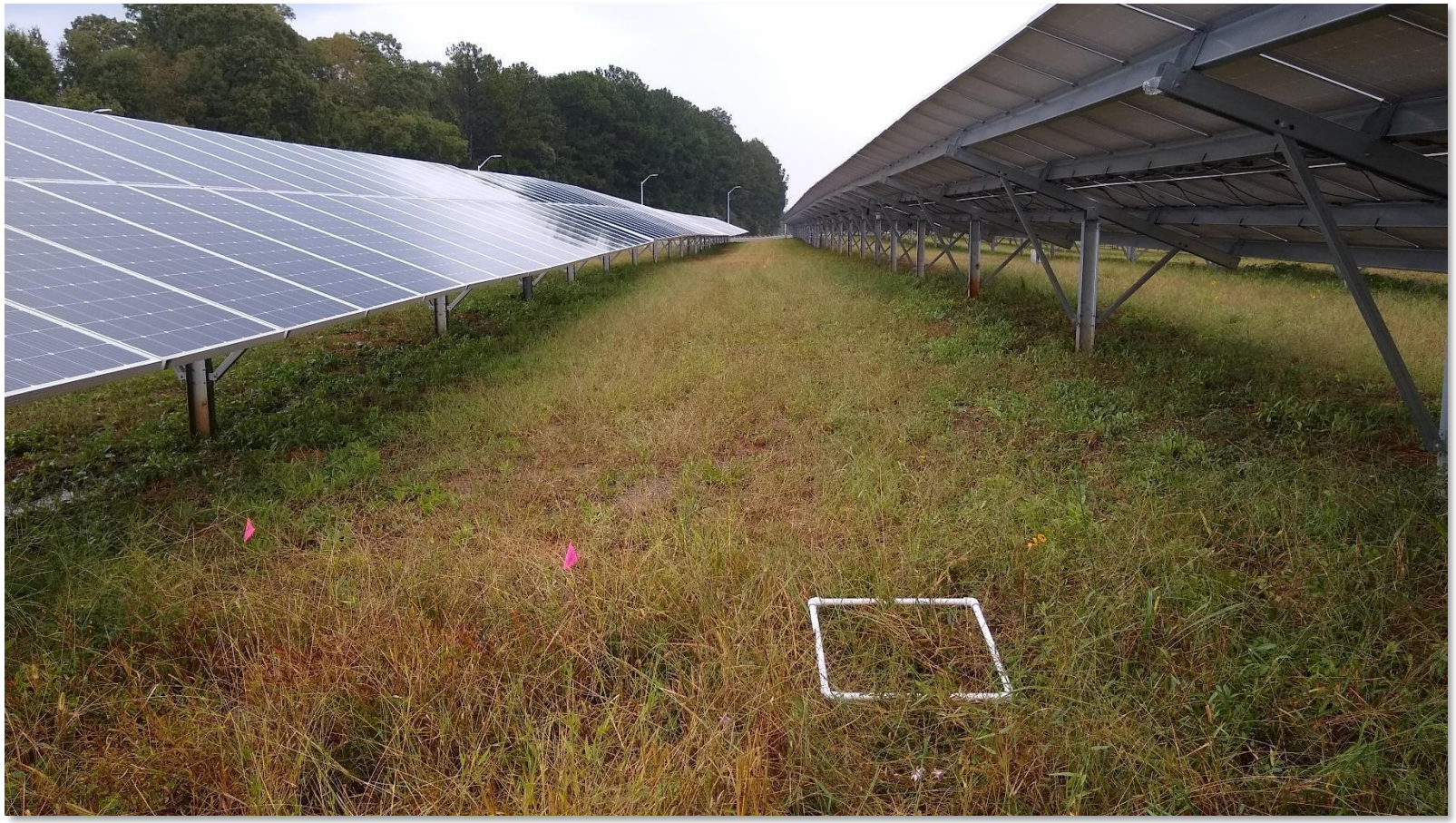
Pollinator Habitat – Seed Mix

- 32 total species
  - 4 graminoids, 28 wildflowers
  - 28 wildflowers - 4 annuals / short-lived perennials
- 95 seeds per square foot
  - 81 seeds perennial - 85.25%
  - 14 seeds annual / short-lived perennials –14.75%
  - 30% graminoids, 70% wildflowers
- 2 annual cover crops - Millet and oats

Traditional Turf – Seed Mix

- Traditional DOT - ‘Contractor Mix’
- Non-native cool-season grasses
  - Fescues and ryes
- Annual rye cover crop

Plant & Pollinator Sampling



Quadrat sampling in Pollinator Habitat, Stantec

SAMPLING METHODS

Vegetation

- Sampled equal number of 0.25-m^2 quadrats in all 4 areas
- Recorded species, percent cover, height, and flowering
- 2021 sampled monthly
  - April – September

Pollinators

- Transect Counts
  - Duration = 15 minutes
  - Length = 200’
  - Visual ID to groups

Key Findings

Percent Cover: Goal - 70% cover within 3 months of seeding

- 2020 – Both seed mixes **failed to meet** this standard
- Pollinator habitat 58% cover and Turf 62% cover
- No significant difference between treatment areas (P=0.306)

Plant Height: Goal – Vegetation remains below 18” to prevent shading

- 2020 – 1 sp., Splitbeard Bluestem, exceeded 18”
- 2021 – 11 sp exceeded 18”
  - Partridge pea, Coreopsis, Indian Blanket, Monarda, Black-eyed Susan, Tall Fescue

Photos: Stantec

Key Findings

Vegetation Indicators:

- Annual / short-lived perennials provided early flowering cover
- **84%** of seeded species germinated
- **73%** of seeded species have flowered
- All 3 species of milkweed germinated
  - Butterfly, Whorled, and Antelope
- Monitoring for invasive species
  - Johnson grass, thistle, callery pear


Photo: A. Bennett


Photo: Prairie Moon

Pollinator Usage:

- **2020 - 70%** more native bees in the Pollinator Habitat
  - 10 of 12 pollinator groups were observed in the Pollinator Habitat
- **2021 – 52%** more native bees in the Pollinator Habitat
  - 11 of 12 pollinator groups observed in Pollinator Habitat; 10 in Turf
  - More bumble bees in turf visiting clovers

Summer 2021
La Grange, GA

Photo: Wes Cunningham, Stantec

Summary & Next Steps

- Vegetation & pollinator sampling complete for 2021
- Currently processing 2021 data
- Monitoring will continue in 2022-2024
- Encouraging early results for the native seed mix
- Developing BMPs for seeding and maintenance
- Tracking costs between pollinator and turf habitat


Photo: A. Bennett


Photo: A. Bennett

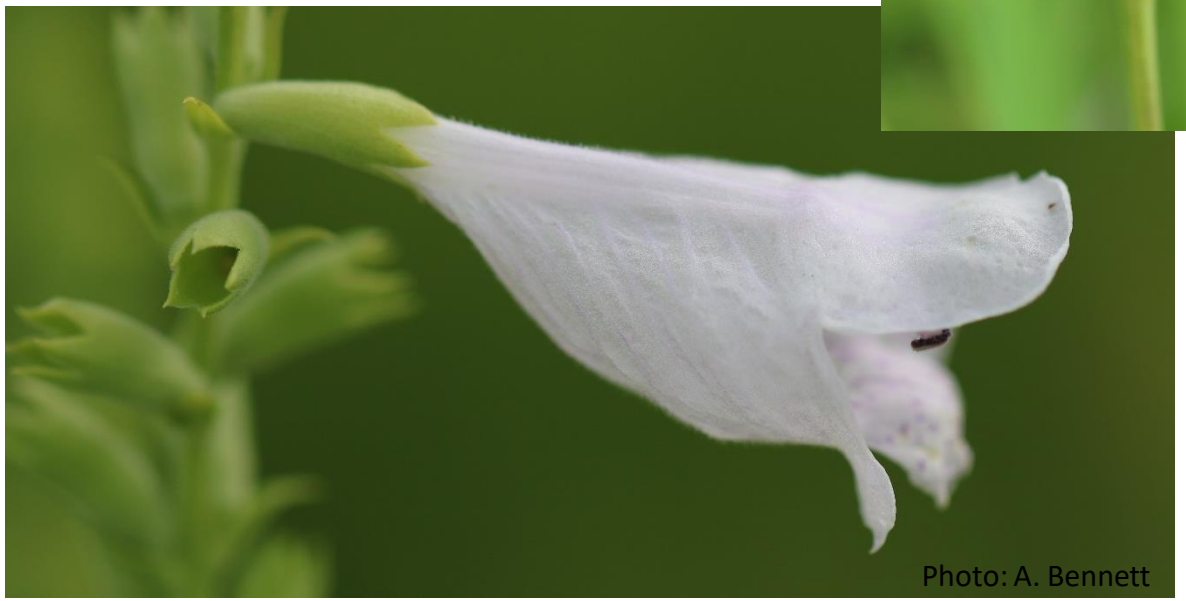


Photo: A. Bennett

Powerline Prairies
AEP, Dawes Arboretum, EPRI

Project Questions

Question 1: Stabilization

- Can stabilization requirements be met within several weeks of seeding?
- Will bare ground remain below 5%?

Question 2: Prairie Species Dominance

- Will native plants remain the dominant vegetative cover after 5 years?

Question 3: Wildlife Utilization

- Will pollinator and bird abundance and richness increase as forbs establish?

Question 4: Effects of Mowing

- Can mowing increase plant diversity?
- Will tree height and cover be lower in mowed subplots?

PRAIRIE RESEARCH DESIGN:

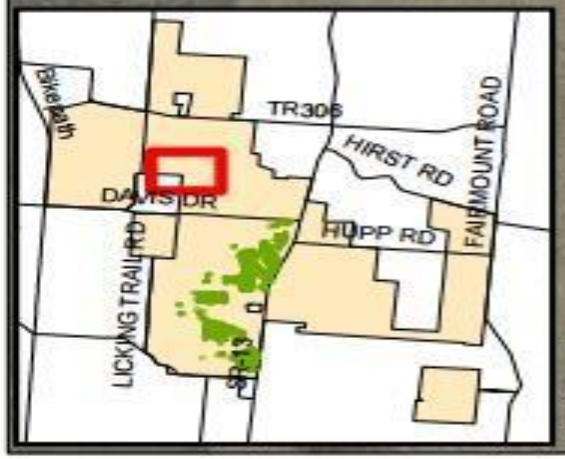
*Single Native Seed Mix

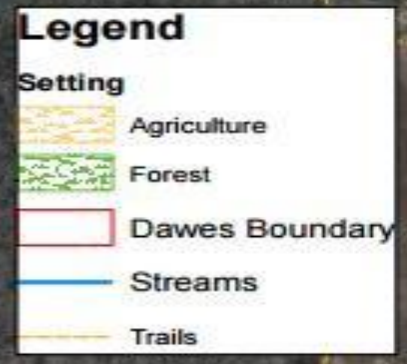
Agricultural plots
ROW Plots ("ROWP") 1-3

Forested plots
ROW Plots ("ROWP") 4-6

Two additional study plots not pictured:
2015 Pilot Plot ("2015P")
Cool-season grass-seeded ROW[1] ("NSROW")

1. Owned by the Energy Cooperative, seeding date unknown





Author: Josh Troyer

Vegetation, Pollinator and Bird Surveys

- Vegetation
  - Quadrat sampling along transects
- Pollinators
  - Timed Transect Walks
  - Timed Quadrat Observations
- Birds
  - Point Counts

Results – Species Establishment

- 2017 – 6 species
  - Annual oats, cover crop
  - Partridge Pea, annual
  - Black-eyed Susan
  - Tall Ironweed
  - Plains Coreopsis
- 2018 – 16 species
- 2019 – 20 species
- 2020 – 21 species
  - All but….
  - Illinois Bundleflower
  - Showy Milkweed
  - Purple Prairie Clover

Common Name	Scientific Name	2017	2018	2019	2020
Partridge Pea	*Chamaecrista fasciculata*	x	x	x	x
Grey-headed Coneflower	*Ratibida pinnata*	-	x	x	x
Wild Senna	*Senna hebecarpa*	-	x	x	x
Virginia Wild Rye	*Elymus virginicus*	-	x	x	x
Black-eyed Susan	*Rudbeckia hirta*	x	x	x	x
Canada Wild Rye	*Elymus canadensis*	x	x	x	x
Sweet brown eyed Susan	*Rudbeckia triloba*	-	x	x	x
Showy Tick Trefoil	*Desmodium canadensis*	-	x	x	x
Little Bluestem	*Schizachyrium scoparium*	-	-	x	x
New England Aster	*Symphyotrichum novae-angliae*	-	x	x	x
Purple Coneflower	*Echinacea purpurea*	-	x	x	x
Oxeye Sunflower	*Heliopsis helianthoides*	-	x	x	x
Tall White Beardtongue	*Penstemon digitalis*	-	-	x	x
Tall Ironweed	*Vernonia gigantea*	x	x	x	x
Swamp Milkweed	*Asclepias incarnata*	-	x	x	x
Lanceleaf Coreopsis	*Coreopsis lanceolata*	-	-	x	x
Prairie Blazing Star	*Liatris pycnostachya*	-	-	x	x
Butterfly Milkweed	*Asclepias tuberosa*	-	-	x	x
Blue False Indigo	*Baptisia australis*	-	x	-	x
Sideoats Grama	*Bouteloua curtipendula*	-	-	x	x
Plains Coreopsis	*Coreopsis tinctoria*	x	x	x	x
Annual Oats	*Avena sativa*	x	-	-	-
Illinois Bundleflower	*Desmanthus illinoensis*	-	x	-	-
Showy Milkweed	*Asclepias speciosa*	-	-	-	-
Prairie Clover	*Dalea purpurea*	-	-	-	-
TOTAL SPECIES OBSERVED		6	16	20	21

Agricultural Plot –August 2017

Forest Plot – August 2017

Agricultural Plot –August 2020

Photos: Dawes Arboretum

Forest Plot – August 2019

Results - Pollinators and Birds

	Bee Groups	Bee Abundance	Butterfly Species	Butterfly Abundance	Bird Species	Bird Abundance
2017	4	69	11	13	15.5	58
2018	4	37	13	61	20	59
2019	8	120	13	61	30	114
2020	8	49	12	85	27	99

* Results are averages across all 6 plots

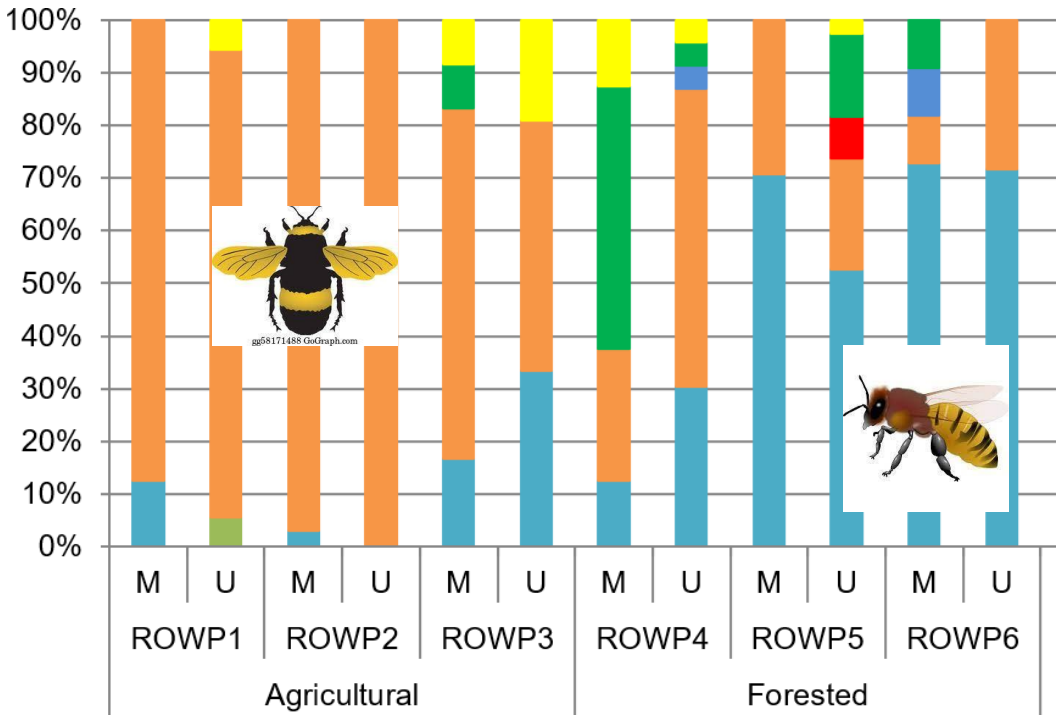
2020: Totals Across All Plots

- 24 butterfly species were observed
- 15 bee groups were observed
- 48 bird species were observed

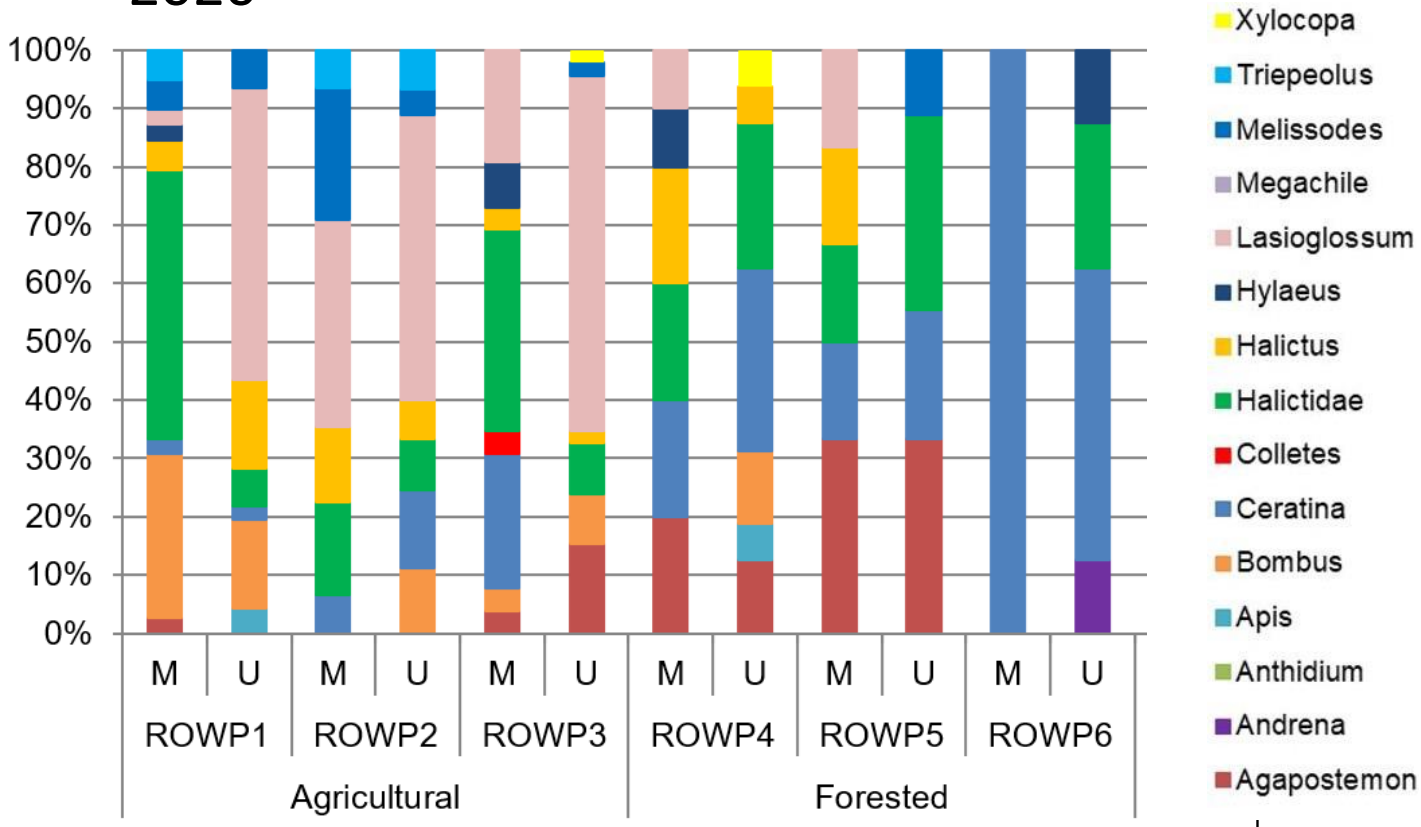
Results: Pollinator Groups

- 2018 dominated by *Bombus* & *Apis*
- 2020 greater bee diversity

2018



2020



Key Findings (2017-2020)

- Native vegetation established within 4 weeks
- 0.15% bare ground by 2018
- 21 of the 24 seeded species had established by 2020
- Annuals and perennials are critical to success.
  - Early cover by black-eyed Susan & Partridge Pea
  - Functional species occupied different niches during establishment
- Mowing increased diversity and cover of seeded species
  - Butterfly milkweed & little blue stem higher cover in mowed plots
- Mowing reduced the tree height & cover but not number
- Bee visitation was 36% higher in mowed plots
- Seeded forbs represented 69% of bee visits to flowers
  - Forbs with high visitation: Black-eyed Susan, Partridge Pea, Lanceleaf coreopsis, Cup plant, and Grey-headed coneflower

New EPRI Research Underway

Objectives

- Determine whether native vegetation can reduce maintenance costs & when
- Identify cost-effective seeding & first-year vegetation management practices
- Document benefits to biodiversity pollinators & bats

Sites

- One ROW and 2 Substations
- Ameren and FirstEnergy – IL and WV

Value

- Experience with establishing and managing native vegetation
- Potential benefits to O&M costs, biodiversity conservation, and community relations

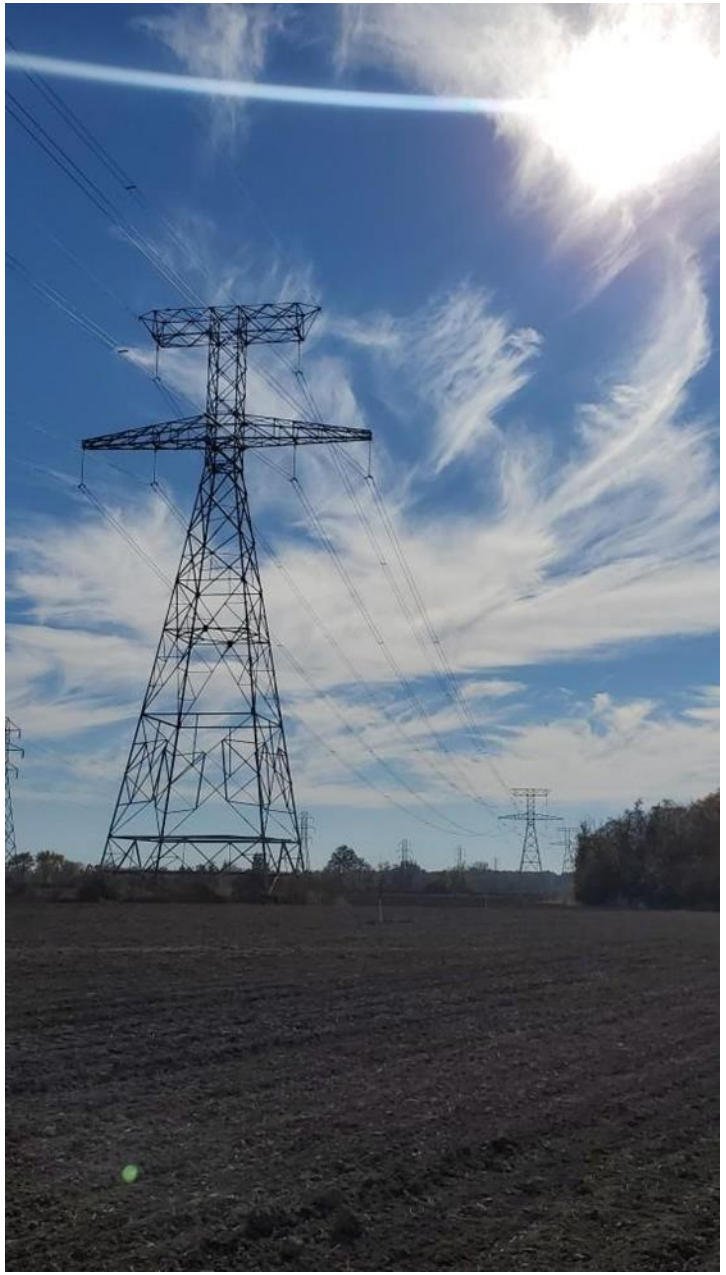


Photo: Kevin Atkins, Ameren

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