



CONNECTIONS **SUMMIT**

◆ ELECTRICITIES

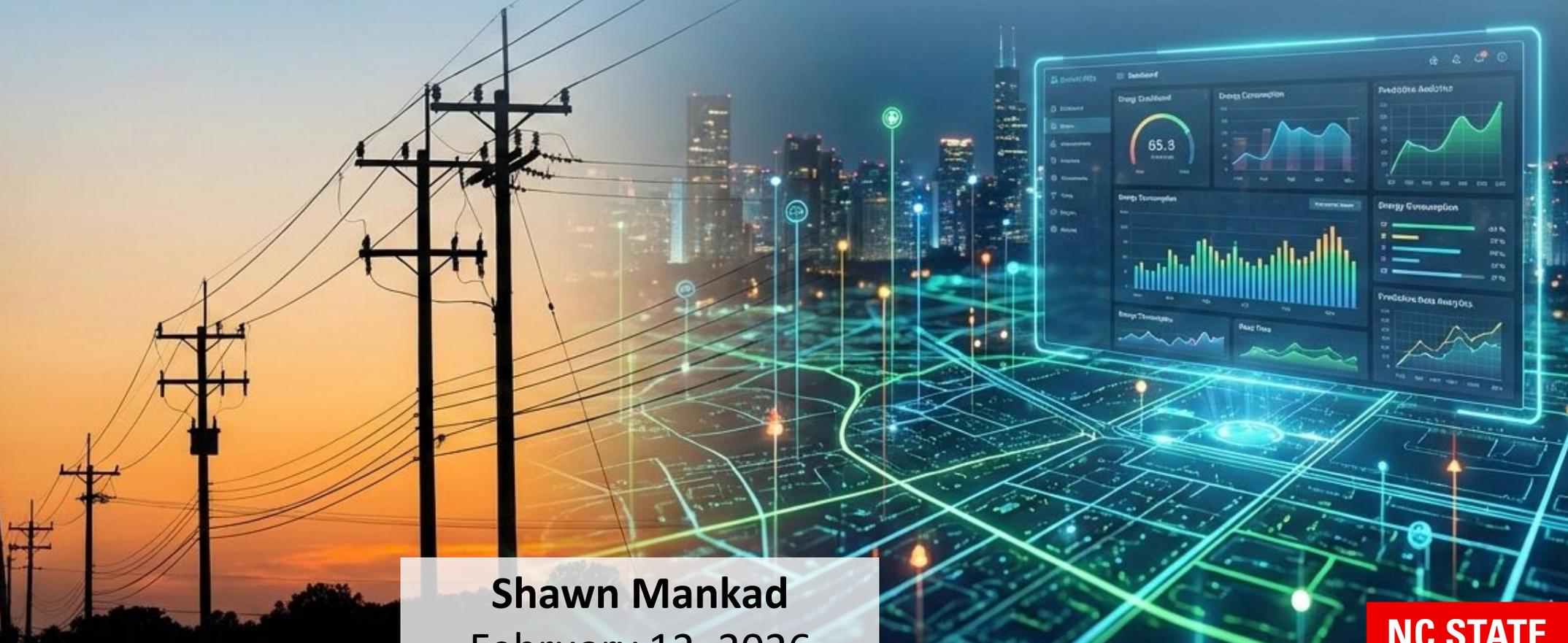
From Insight to Impact: Leveraging Data Visualization for Smarter Utility Decisions

Shawn Mankad, Ph.D.

Andrew Mitchell

From Insight to Impact

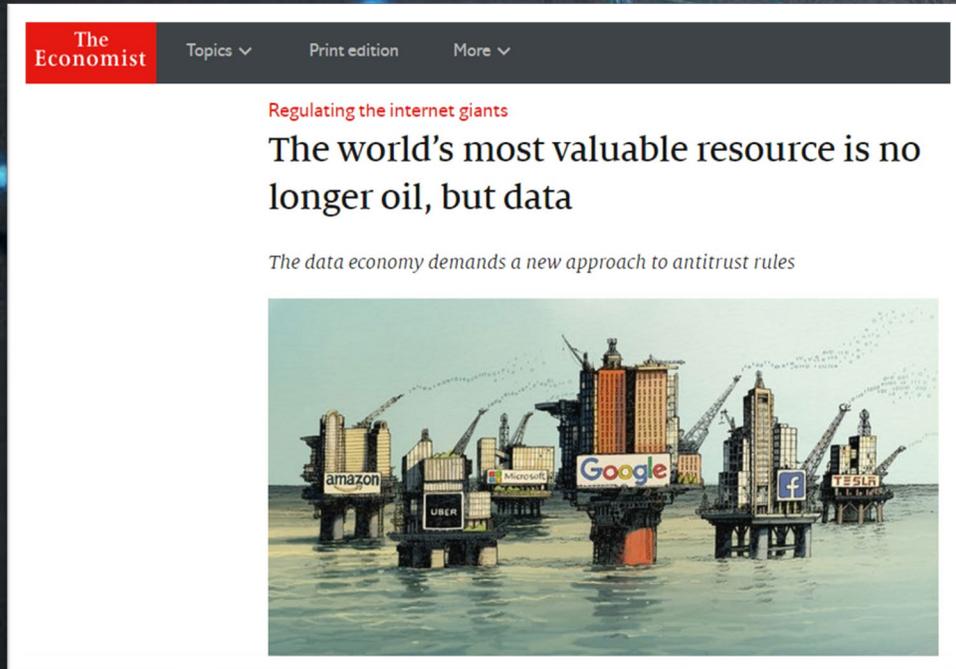
Using Analytics to Power Smarter Utilities



Shawn Mankad
February 12, 2026

THE NEW INFRASTRUCTURE

Data is foundational.



The Economist

Topics ▾ Print edition More ▾

Regulating the internet giants

The world's most valuable resource is no longer oil, but data

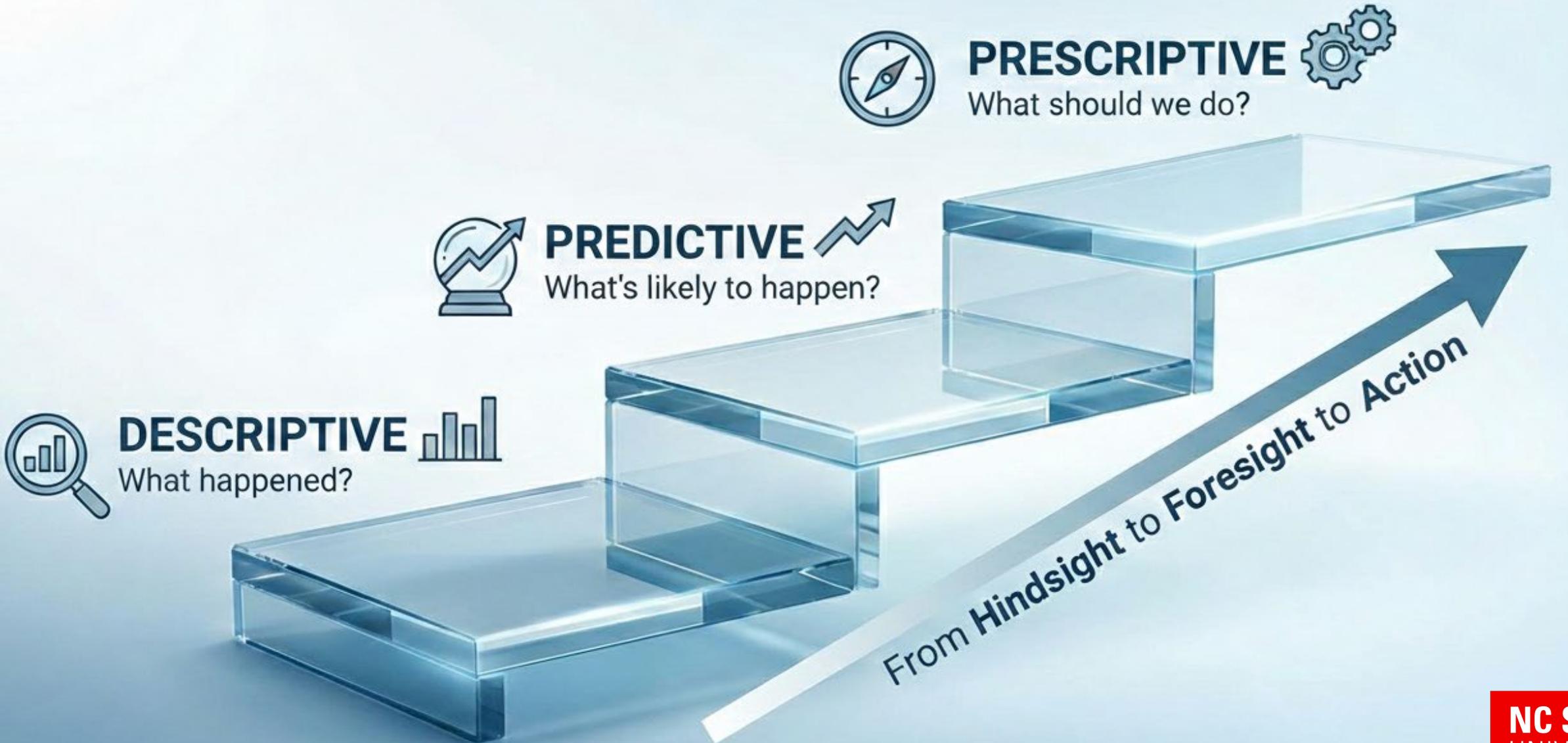
The data economy demands a new approach to antitrust rules



“In God we trust;
all others must bring data.”

— W. Edwards Deming

THE ANALYTICS LADDER



DATA REQUIREMENTS

Analytics Type	Methods & Software	Data Requirements
Descriptive	Business Intelligence & Dashboards	Data Readiness: Organized historical records and reliable reporting systems.
Predictive	Regression, Forecasting & Machine Learning	Training Data: High-quality "labeled" examples of past events to teach the system.
Prescriptive	Optimization & Digital Twins	Real-Time Connectivity: Continuous data streams and automated feedback loops.

ANALYTICS USE CASES



Finance

- Accurate Budget Forecasting
- Revenue Recovery
- Capital Planning Insights



Customer Service

- Proactive Customer Alerts
- Reduced Call Volume
- Personalized Dashboards



Logistics / Operations

- Predictive Maintenance
- Optimized Crew Deployment
- Faster Outage Response

ANALYTICS ROI



Finance

60% CAPEX savings when prioritizing investments based on risk versus age¹



Customer Service

22% decrease in bill related calls after implementing proactive alerts²

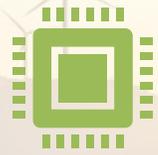


Logistics / Operations

40% reduced downtime and 30% lower maintenance costs with predictive maintenance³

1 Oxand case study; 2 Oracle Eversource case study; 3 U.S. Department of Energy

KEY TAKEAWAYS



Data is Infrastructure

Our digital backbone is as critical as our physical one.



Climb the Ladder

We must move from Descriptive (Hindsight) to Prescriptive (Foresight)



The ROI is Proven

Real value: CAPEX Savings, Better Customer Service and Operational Efficiency

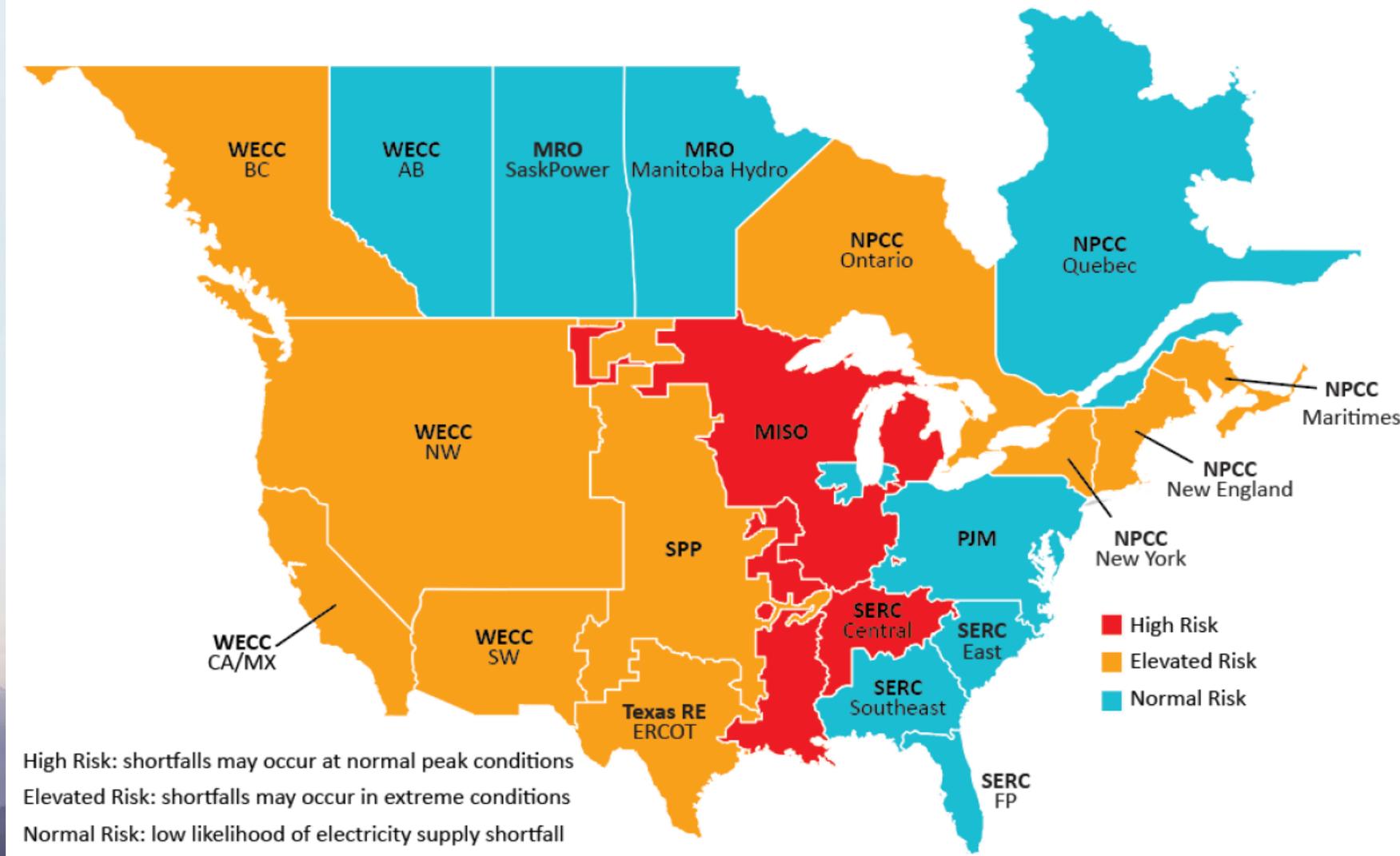
An aerial view of a city with a network of glowing blue lines and nodes overlaid, representing data or utility connections.

From Insight to Impact: Using Analytics to Power Smarter Utilities



ElectriCities Presentation

NERC Long-Term Reliability Assessment (2024-2028)



See www.nerc.com/pa/RAPA/ra/Pages/default.aspx for latest reliability assessments

Utility Analytics – Choosing the right one for the job?



SEPA Utility Transformation - 2021

Enhanced Digitization, Automation and Coordination

Increased digitization is necessary for utilities to increase their visibility, efficiency and capabilities. Examples include: extending digital access to customers, expanded metering capabilities (e.g., advanced metering infrastructure, or AMI, distribution SCADA), digitizing and automating DER interconnection processes, and more broadly, obtaining more-granular visibility into the electricity system and the actions of customers and technology and solution providers.

Industry stakeholders have long viewed automated data—processed through technology such as AMI—as an important step in grid modernization. However, beyond billing efficiencies, most respondents are not maximizing their investments in data automation by supporting key, beneficial grid applications:

- **EV Connections:** 33% of all respondents are using automated data to determine or measure EV connections.
- **Load Disaggregation:** 31% of all respondents are using automated data for load disaggregation.
- **Visibility of Grid Operation** (e.g., Volt/VAR Optimization): 46% of all respondents are using automated data for visibility of grid operation (e.g., for voltage and VAR optimization).
- **Load Forecasting + Hosting Capacity Analysis:** 25% of all respondents are using automated data for load forecasting and hosting capacity analysis.

Over the past two decades, state regulators have led top-down efforts to streamline and improve DER distribution interconnection procedures, transforming interconnection from a clunky, time-intensive process to a more-efficient, automated process. Ongoing improvements have allowed (or required) utilities to process rising volumes of DER interconnection requests, and to accommodate newer and more complex DER systems—including energy storage—more easily.

 Digitization	<ul style="list-style-type: none">■ 51% of all respondents provide an online portal that indicates the status of a DER interconnection application.■ 80% of all respondents offer an e-submission option for DER interconnection applicants.
 Efficiency	<ul style="list-style-type: none">■ 97% of all respondents have a tiered interconnection review process based on DER system size and complexity.■ 96% of all respondents have an expedited review process for smaller, inverted-based DER systems.
 Advanced Capabilities for DER Integration	<ul style="list-style-type: none">■ 59% of all respondents have specific interconnection provisions to accommodate energy storage systems.

Increased digitization, automation and coordination are key pillars of utilities' efforts to cultivate a more interconnected, data-driven grid with expanded functionalities. They will be instrumental for establishing a foundation for a modern, carbon-free grid. The result is a grid capable of integrating more DERs, responding faster to load shifts, and more accurately forecasting system needs.

DOE Grid Modernization Initiative (GMI)

The MODERN GRID must have:

- Greater **RESILIENCY** to hazards of all types

- Enhanced **SECURITY** from an increasing and evolving number of threats

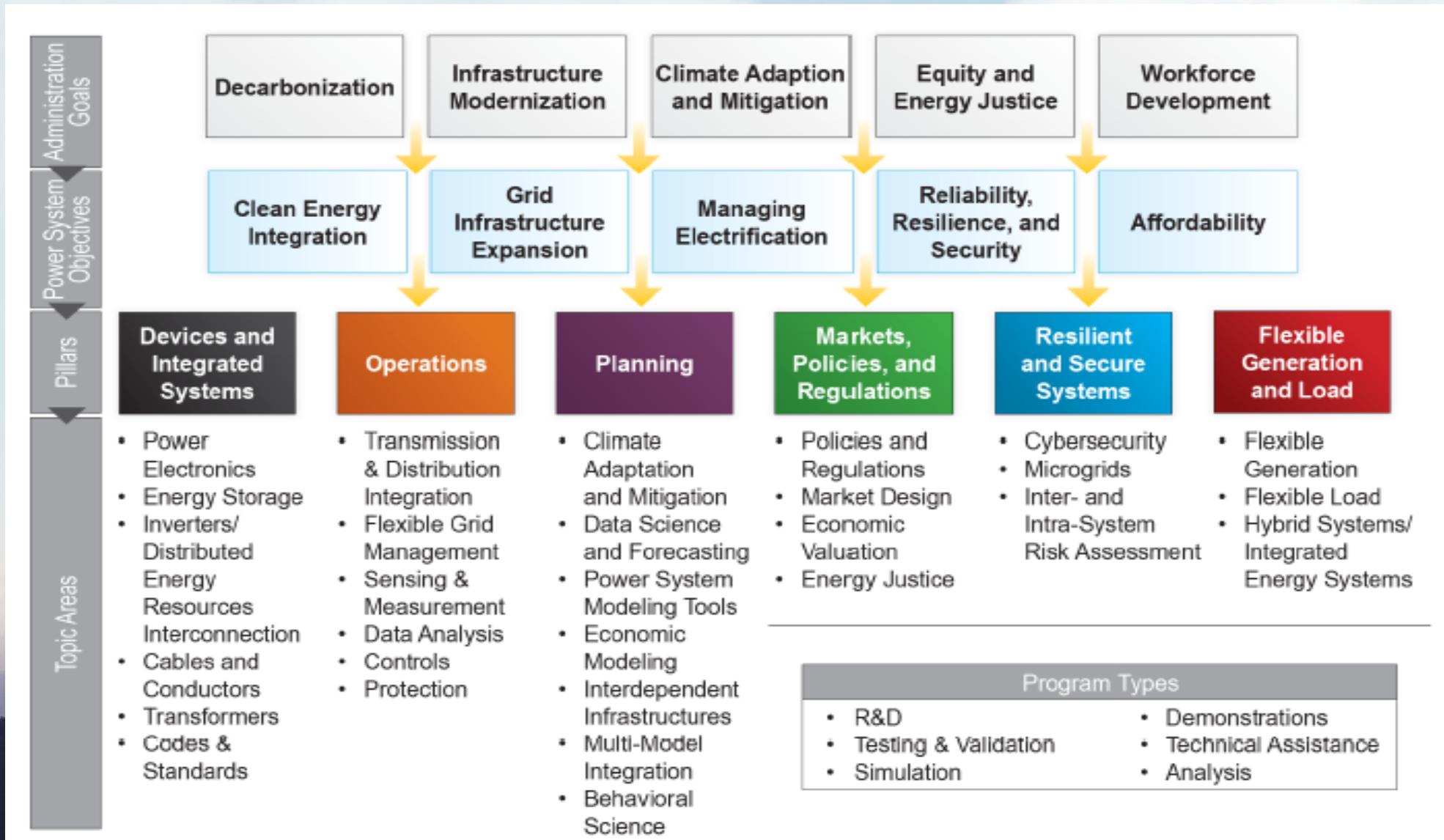
- Superior **FLEXIBILITY** to respond to variability and uncertain conditions

- Improved **RELIABILITY** for everyday operations

- Additional **AFFORDABILITY** to maintain our economic prosperity

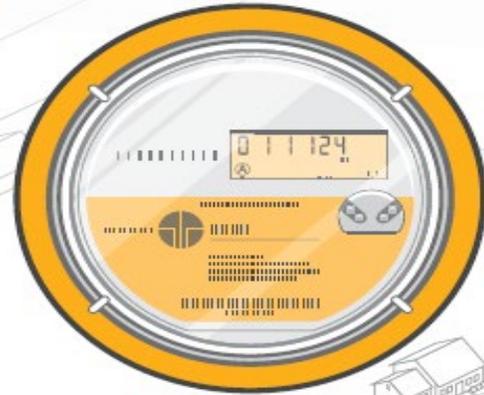
- Increased **SUSTAINABILITY** through energy-efficient and renewable resources

DOE – Six Pillars for Grid Modernization



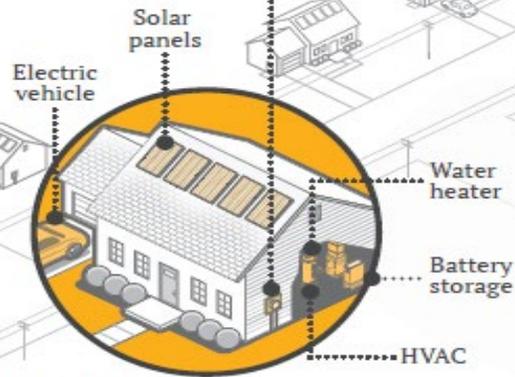
AMI 2.0

Advanced metering infrastructure or AMI has been the state of the art for utilities for the past 20 years, and electric cooperatives have been among its earliest and most aggressive adopters. Now, as those first-generation meters begin to age out, highly advanced AMI 2.0 systems are set to revolutionize the industry, with new edge-computing and data collection and analysis capabilities that promise to enable multiple new applications and improve the reliability and flexibility of the grid. Here are some of the benefits of AMI 2.0.



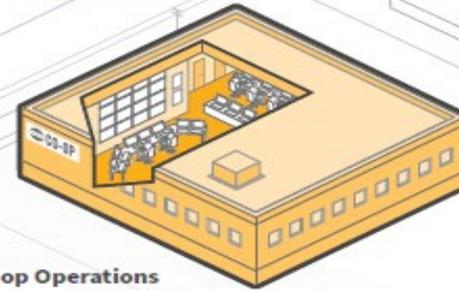
Meter Features

- Faster, more accurate readings.
- More frequent transmissions.
- Enable greater control of energy-producing and consuming devices.
- Sample voltage and amperages on demand.
- Independently detect anomalous conditions.
- Applications pushed to meters to meet new needs.
- Faster processor.
- Increased memory.
- Longer-lasting batteries.



Member Benefits

- Better integration of distributed energy resources.
- Ability to combine a standard meter and a net meter into a single unit.
- Improved customer awareness of consumption, pricing.
- Real-time home energy management, load control and outage/usage alerts.

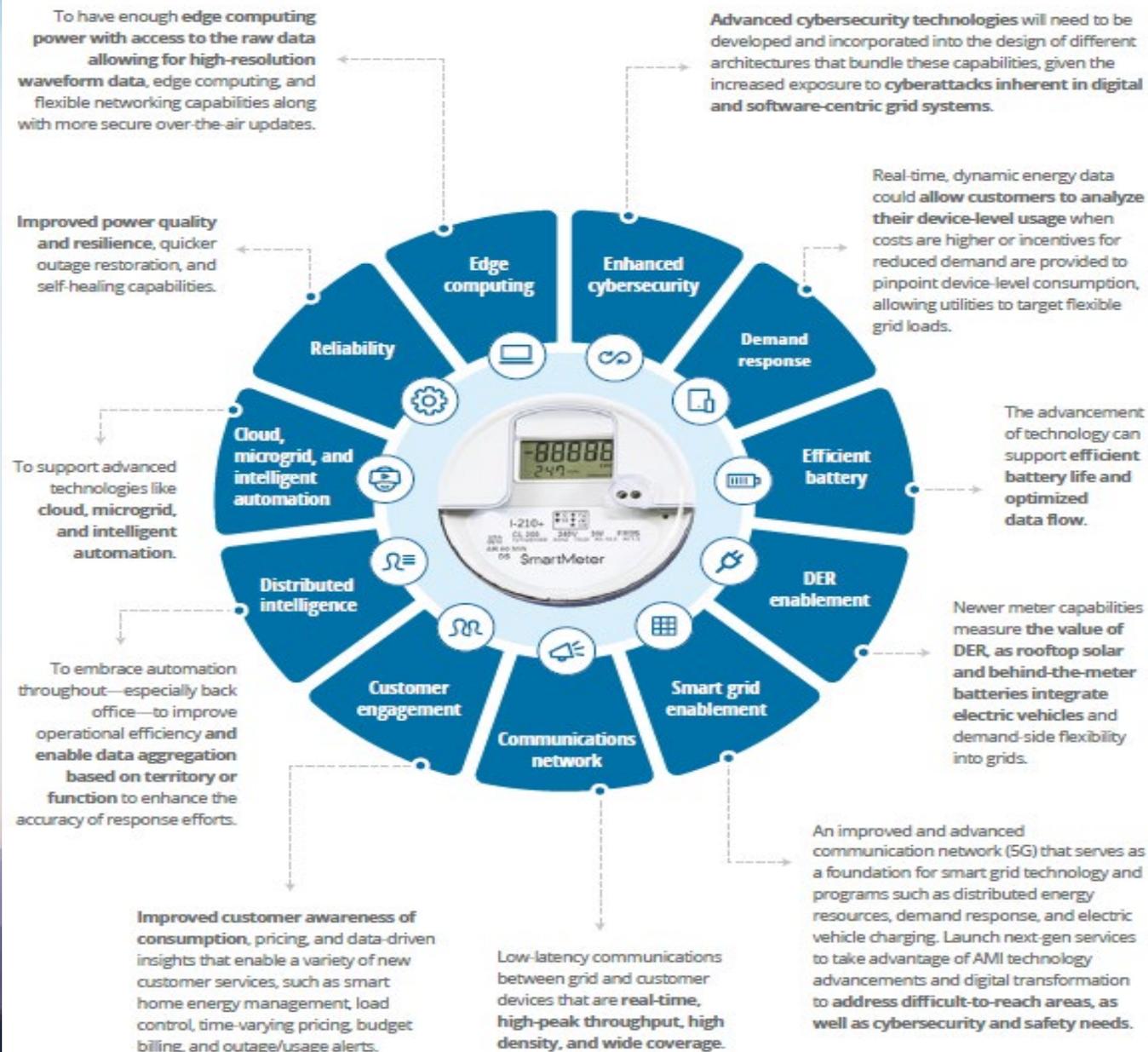


Co-op Operations

- Better data acquisition and analytics at grid edge.
- Improved member engagement.
- Integration and tracking of DERs.
- Design innovative energy programs.
- Evaluate, measure and verify cost/energy savings.
- Improved power quality and resilience.
- Quicker outage restoration.
- AMI network self-healing capabilities.
- Load disaggregation functionality.
- Virtual power plants.

Source: NRECA, Design: Jeff Donlavey

Summary view of the capabilities Deloitte anticipates from AMI 2.0-enabled meters



Step by step implementation process

AI-first vendors: step-by-step implementation process for typical AI-first asset management software deployment



Involve stakeholders to define business objectives, constraints and user requirements

Step 1

Understand the problem



Identify relevant data sources. Collect high-quality data

Step 2

Acquire or install sensors to collect data



Refine models with training data. Use feature engineering, tuning and selection

Step 3

Train machine learning models on data



Integrate models into production systems. Ensure scalability, reliability and maintainability

Step 4

Productionalize machine learning models



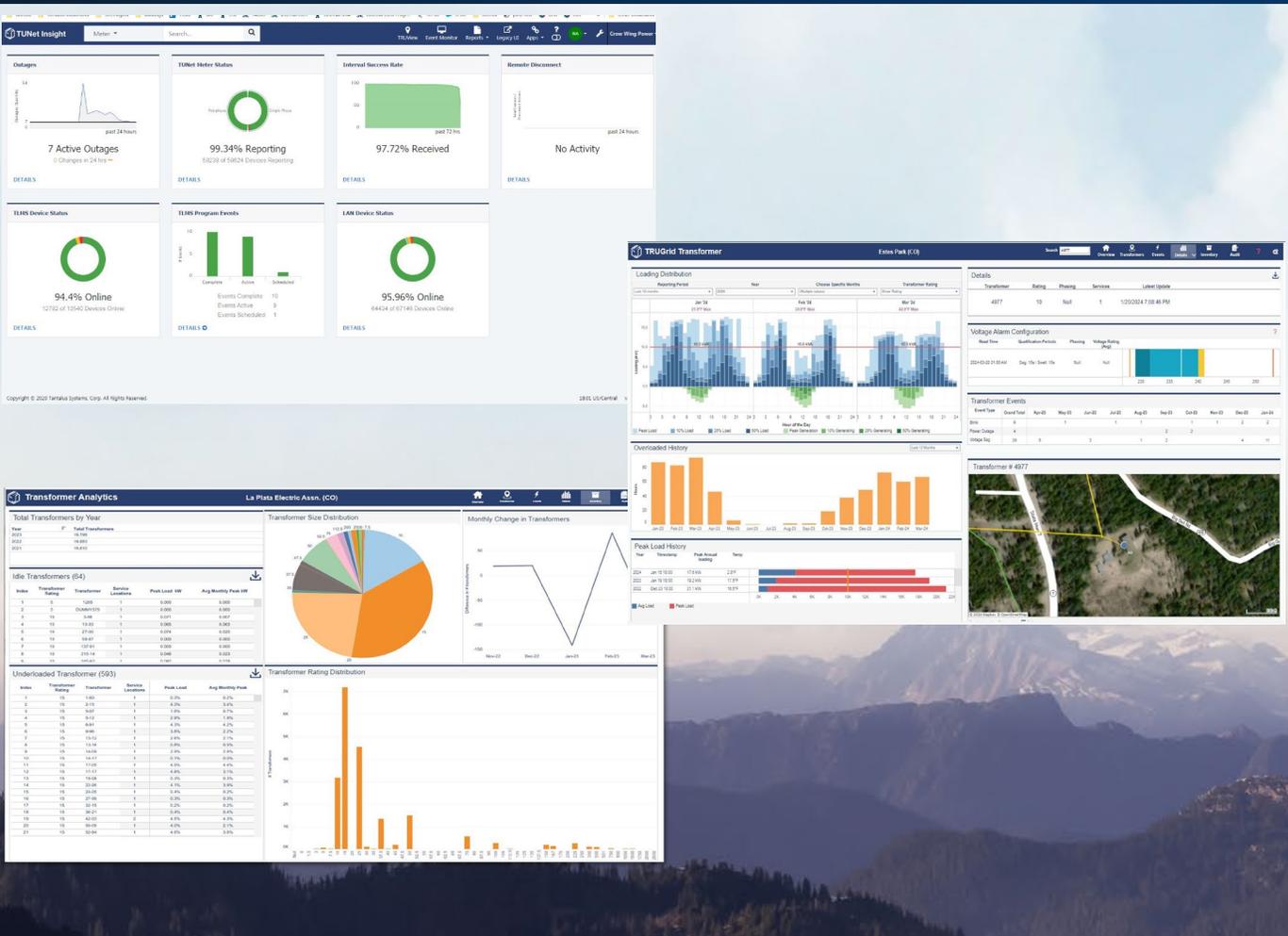
Monitor and update models for accuracy, avoiding model drift

Step 5

Continuously monitor model performance and retrain as necessary

Access to Granular Data Leads to Predictive Analytics

Enabling utilities to protect transformers and pinpoint vulnerabilities through power quality data



Software / Predictive Analytics Offering

Common user interface designed alongside our user community provides real-time insights across the utility

Insights from our software supports operations and engineering teams

Analytics tied to protecting transformers & improving grid reliability

Enables utilities to predict and take proactive measures to protect assets and mitigate outages

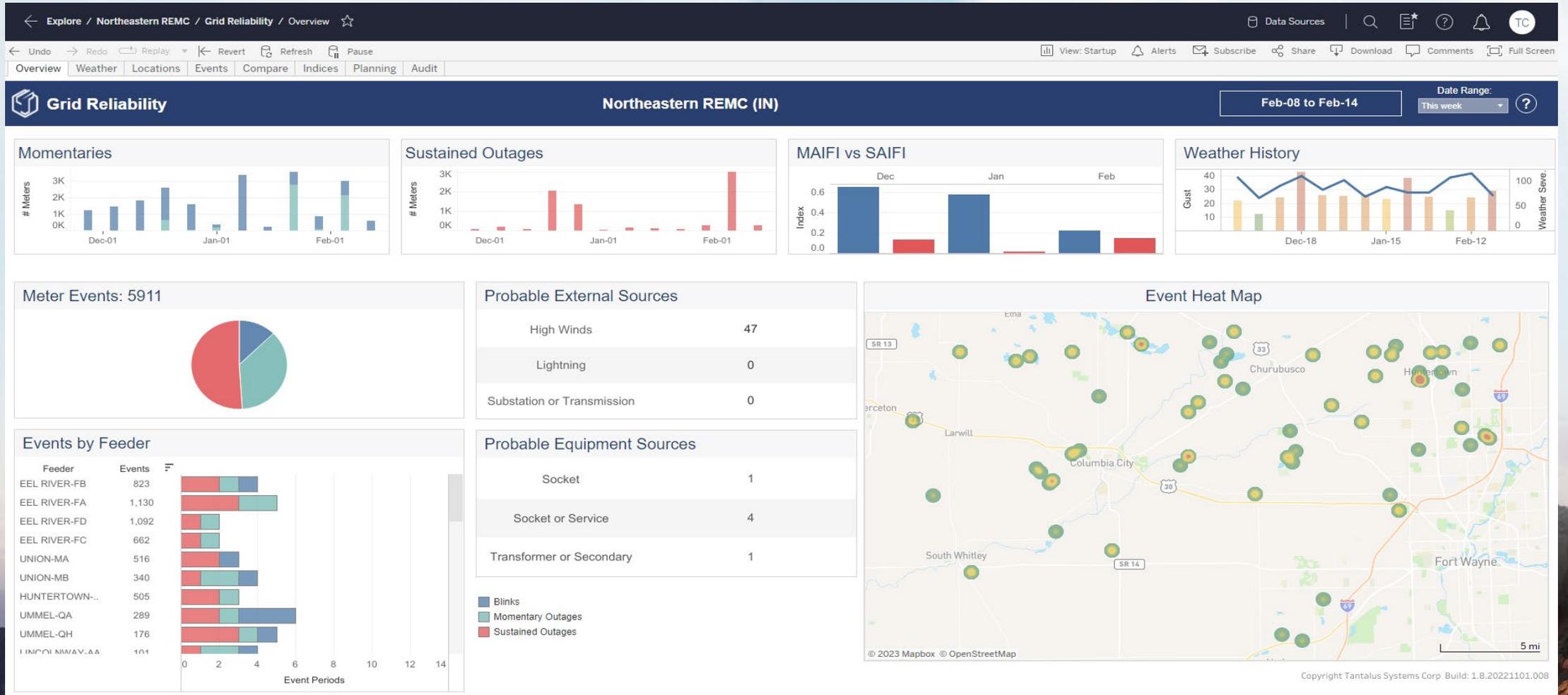
Grid Reliability Analytics

- Leverages interval data from any AMI system
- Performs deep analytics
- Identify issues on the distribution system
- Continuously analyzes power-quality data
- Alerts
 - Failing transformers
 - Corroded meter sockets and splices
 - Cracked insulators
 - Other latent equipment problems



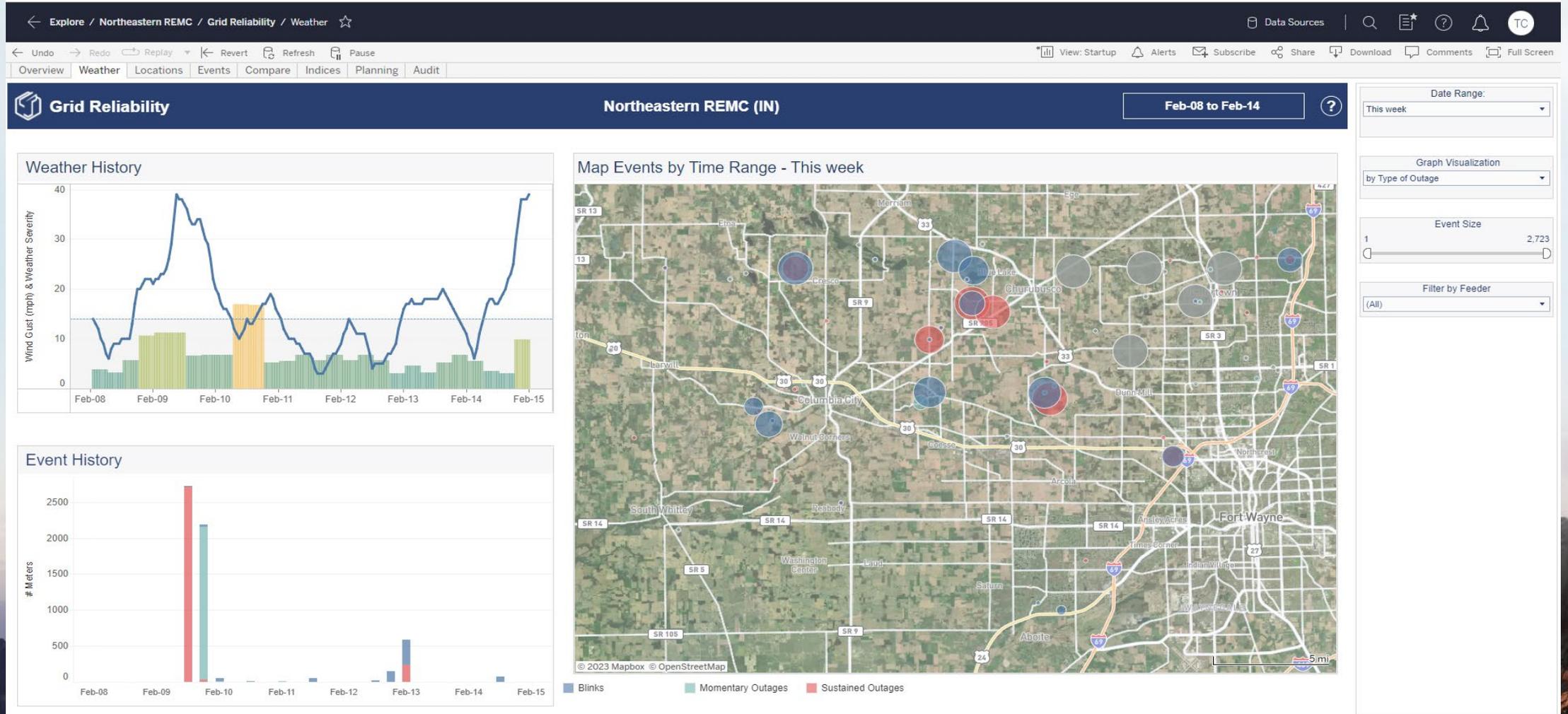
Grid Reliability

Distribution Grid Health – Weekly View



Grid Reliability

Hourly to yearly effects of weather on the distribution grid



Check Timing Sequences – Verify

← Explore / Northeastern REMC / Grid Reliability / Events ☆
Data Sources | 🔍 | 📄 | ? | 🔔 | TC

← Undo → Redo ↺ Replay ▾ ↶ Revert ↻ Refresh ⏸ Pause
View: Startup | 🔔 Alerts | ✉ Subscribe | 🗑 Share | 📄 Download | 💬 Comments | 🖥 Full Screen

Grid Reliability
Northeastern REMC (IN) Feb-08 to Feb-14 ?

Event Period Details (17)

Date Time Period	Worst Weather	Relative Wind Gust Strength	Median Temp	Feeder	Event Size Category	Unique Locations	Meter Events	% Feeder	Blinks	Blinks per Meter	Outages	Avg Duration (min)
2023-Feb-12 12:00	Sunny	-3	34 F	GATEWAY-GC	Lateral/Feeder	25	25	5%	27	1.1		
2023-Feb-11 12:00	Sunny	-5	28 F	GATEWAY-GC	Lateral/Feeder	57	57	11%	62	1.1		
2023-Feb-11 00:00	Clear	5	28 F	LINCOLNWAY-AA	Lateral/Feeder	14	14	4%		0.0	14	2
2023-Feb-10 18:00	Light snow show..	3	36 F	EEL RIVER-FA	Location	1	1	0%		0.0	1	8
2023-Feb-10 12:00	Light snow showers	0	35 F	ABOITE-WG	Transformer	5	5	1%	6	1.2		
				GATEWAY-GC	Location	1	1	0%		0.0	1	127
2023-Feb-10 00:00	Overcast	18	38 F	GATEWAY-GC	Location	1	1	0%		0.0	1	0
				PERRY-KA	Lateral/Feeder	53	53	9%	49	0.9	5	99
2023-Feb-09 18:00	Overcast	22	42 F	CLEVELAND-CA	Transformer	2	2	0%		0.0	2	0
				DUPONT-DB	Location	1	1	0%		0.0	1	0
				DUPONT-DF	Location	1	1	0%		0.0	1	0
				EEL RIVER-FA	Substation/Transmission	563	563	97%		0.0	563	0
				EEL RIVER-FB	Substation/Transmission	410	410	96%		0.0	410	0
				EEL RIVER-FC	Substation/Transmission	331	331	98%		0.0	331	0

Events Map

Feeder	Meter Serial Number	Ph	Blinks	Momentary Outages	Sustained Outages
Totals			49	0	5
	138055	C	2	0	0
	523561	C	1	0	0
	523218	C	1	0	0
	522894	C	1	0	0
	505838	C	1	0	0
	505837	C	1	0	0
	505836	C	1	0	0
	505835	C	1	0	0
	505823	C	1	0	0
	505822	C	1	0	0
	505815	C	1	0	0
PERRY-KA	505813	C	1	0	0

Date Range: This week

Outage Source: Show All

Select Event Period: (All)

Filter by Feeder: (All)

Event Size Category

- (All)
- Lateral/Feeder
- Location
- Recloser

Relative Wind Strength

-7.00 25.00

Outage Type: (All)

Blinks per Meter

0.0 78.0

Worst Weather: (All)

Find Meter Serial

Highlight Meter Serial Number

Indices Tracking – Daily, Weekly, Monthly, Annually

← Explore / Tantalus Bookmarks Grid Reliability / Indices ☆ Data Sources

← Undo → Redo ↺ Replay ↶ Revert ↻ Refresh ⏸ Pause View: Startup Alerts Subscribe Share Do

Overview Weather Locations Events Compare Indices Planning Audit


Northeastern REMC (IN)
?

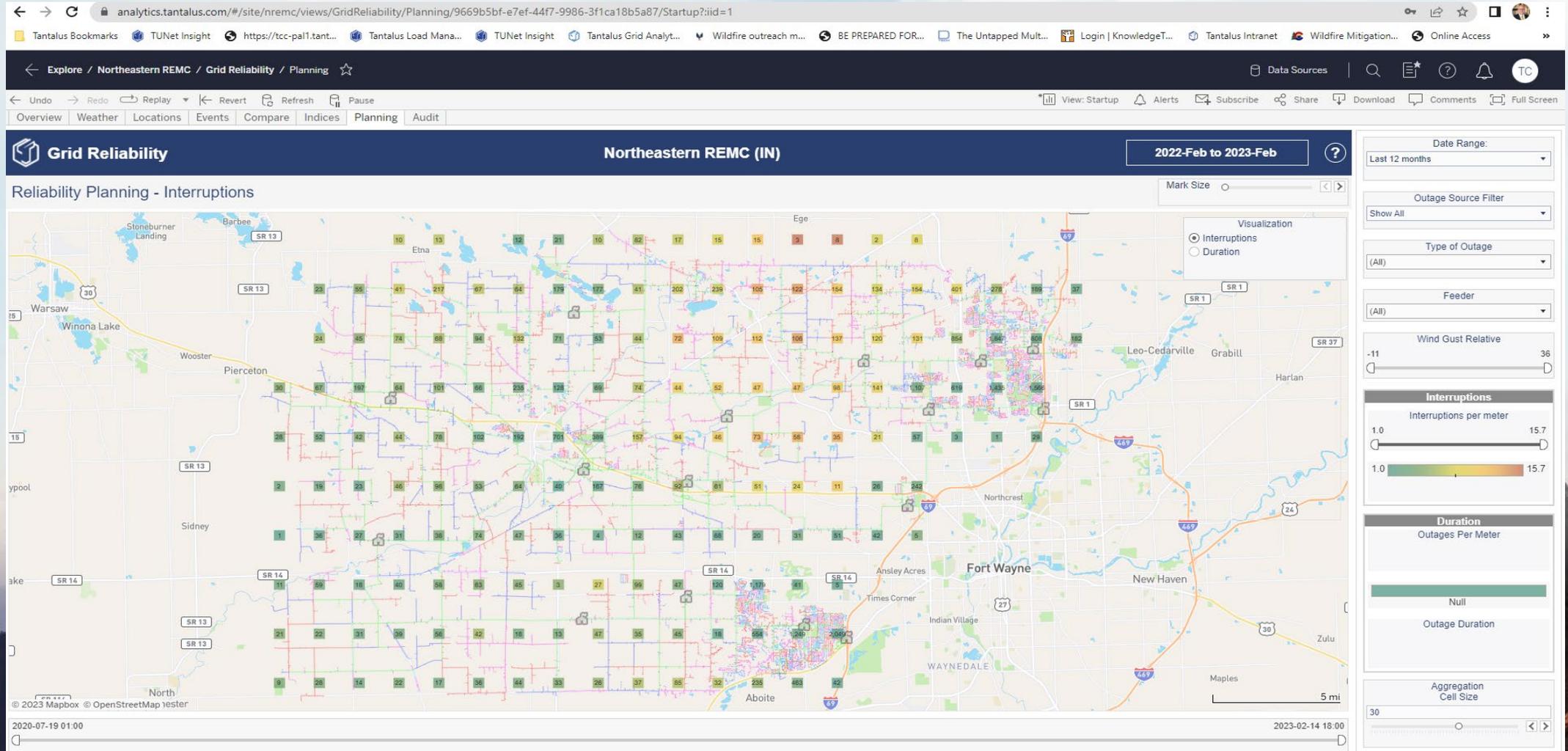
Indices Overall

Year	Report Days	Total Meters	Total Provisioned Commercial Meters	Blinks	Momentary Outages	Sustained Outages	Aggregate Outage Minutes	MAIFI	SAIFI	SAIDI	CAIDI
2023	365	28,126	577	122,858	42,577	31,728	1,314,014	5.9	1.1	47	41
2022	365	30,590	577	494,589	33,632	52,936	23,220,031	17.3	1.7	759	439

Feeder	Total Meters	Total Provisioned Commercial Meters	Commercial Customers Interrupted	Blinks	Momentary Outages	Sustained Outages	Outage Minutes	MAIFI	SAIFI	SAIDI	CAIDI
Totals	30,590	559	137	508,181	38,720	56,651	23,316,279	17.88	1.85	762	412
GATEWAY-GC	521	14	2	75,254	134	767	1,186,464	144.70	1.47	2,277	1,547
ABOITE-WA	858	12	3	58,230	826	999	188,204	68.83	1.16	219	188
COVENTRY-OA	1,135	5	0	50,321	754	1,257	238,668	45.00	1.11	210	190
HUNTERTOWN-HD	1,342	5	2	36,621	1,327	3,670	365,974	28.28	2.73	273	100
UMMEL-QA	818	8	3	23,686	135	4,490	2,139,915	29.12	5.49	2,616	477
HUNTERTOWN-HB	1,485	5	2	22,387	115	123	15,852	15.15	0.08	11	129
EEL RIVER-FD	566	4	3	15,170	6,517	3,357	398,069	38.32	5.93	703	119
EEL RIVER-FA	580	0	0	11,462	8,484	2,513	343,518	34.39	4.33	592	137
GATEWAY-GD	1,115	33	18	11,325	53	3,412	1,002,505	10.20	3.06	899	294
UNION-MA	360	3	1	11,279	3,434	1,231	874,037	40.87	3.42	2,428	710
UMMEL-QH	645	4	0	11,052	131	1,504	1,608,904	17.34	2.33	2,494	1,070
LINCOLNWAY-AA	348	9	6	10,053	81	2,424	343,840	29.12	6.97	988	142
INDIAN CREEK-IB	472	4	0	9,841	28	2,234	145,110	20.91	4.73	307	65
RICHLAND-RB	469	16	6	8,511	505	914	1,183,157	19.22	1.95	2,523	1,294
UNION-MB	264	6	2	8,502	2,638	1,098	528,063	42.20	4.16	2,000	481
RICHLAND-RC	576	6	2	9,165	501	1,411	1,414,200	15.20	2.45	2,455	1,002

Grid Reliability Analytics

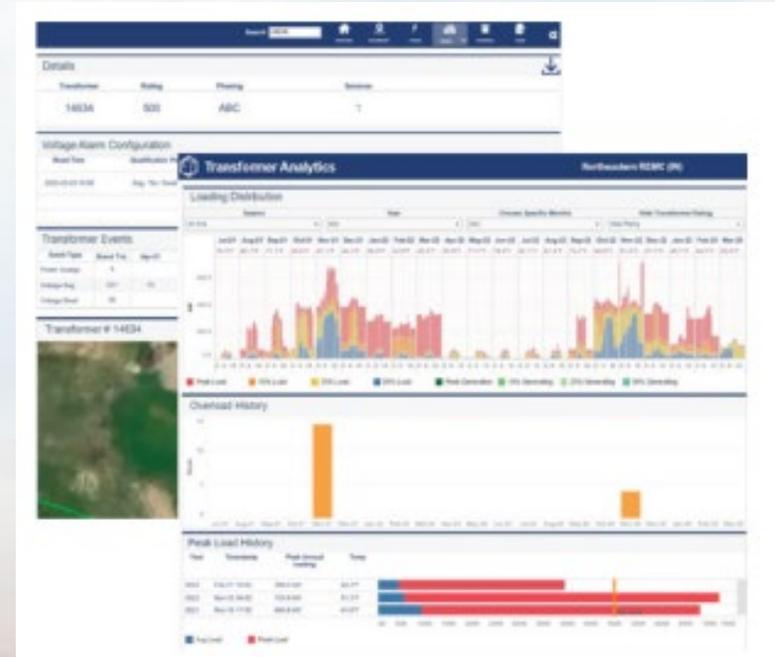
Plan using analytics – daily - yearly view for CAPEX planning



Transformer Analytics

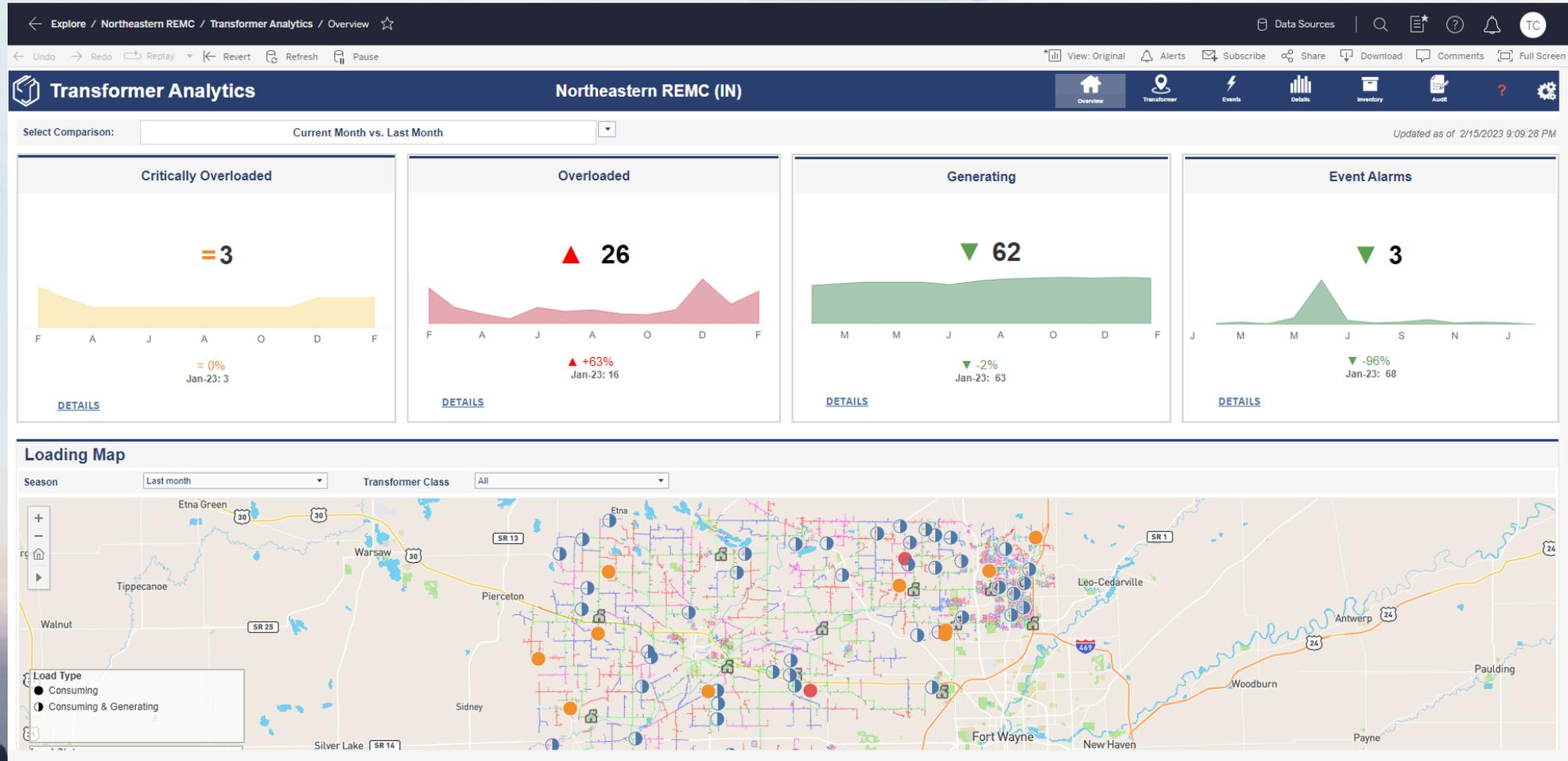
Real-Time Transformer Data Across the Grid

- Track how many hours a transformer has been under- or over-loaded
- See when it is time to replace or repair a transformer and prevent the next catastrophic outage
- Map-based visualization with drill down
- Reduce expenses from damaged or broken units
- Prevent outages that impact revenue
- Plan ahead for sags or swells in demand
- Allows for quicker decision making



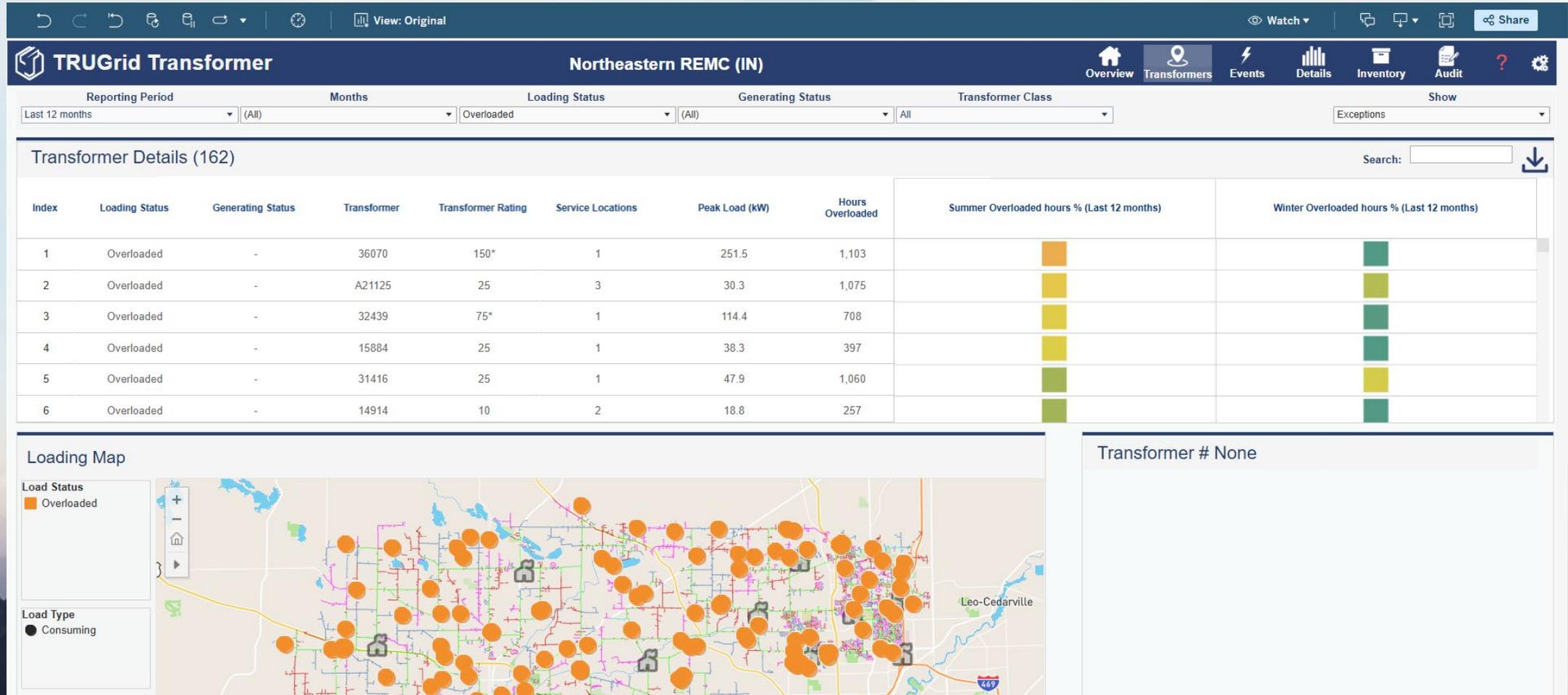
Transformer Analytics

Conserving Your Essential and Hard to Replace Transformer Assets



Transformer Analytics

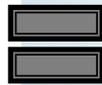
Hours of Overload by color and season



Load – EVs on Local Demand



ONE Ford F150 Lightning
with extended range package



SIX residential central
air conditioning units

19.2 kW



Behind-the-Meter Integrations



SAVANT



Fast Charging Facilities



Fleet Charging, Vehicle-to-Grid



Microgrids



Commercial-Scale Energy Storage

Smart Panel Technology

EV Charging

Battery Storage

Smart Thermostats

Smart Plugs

Lighting

Smart Water Heaters

HVAC

Smart Appliances



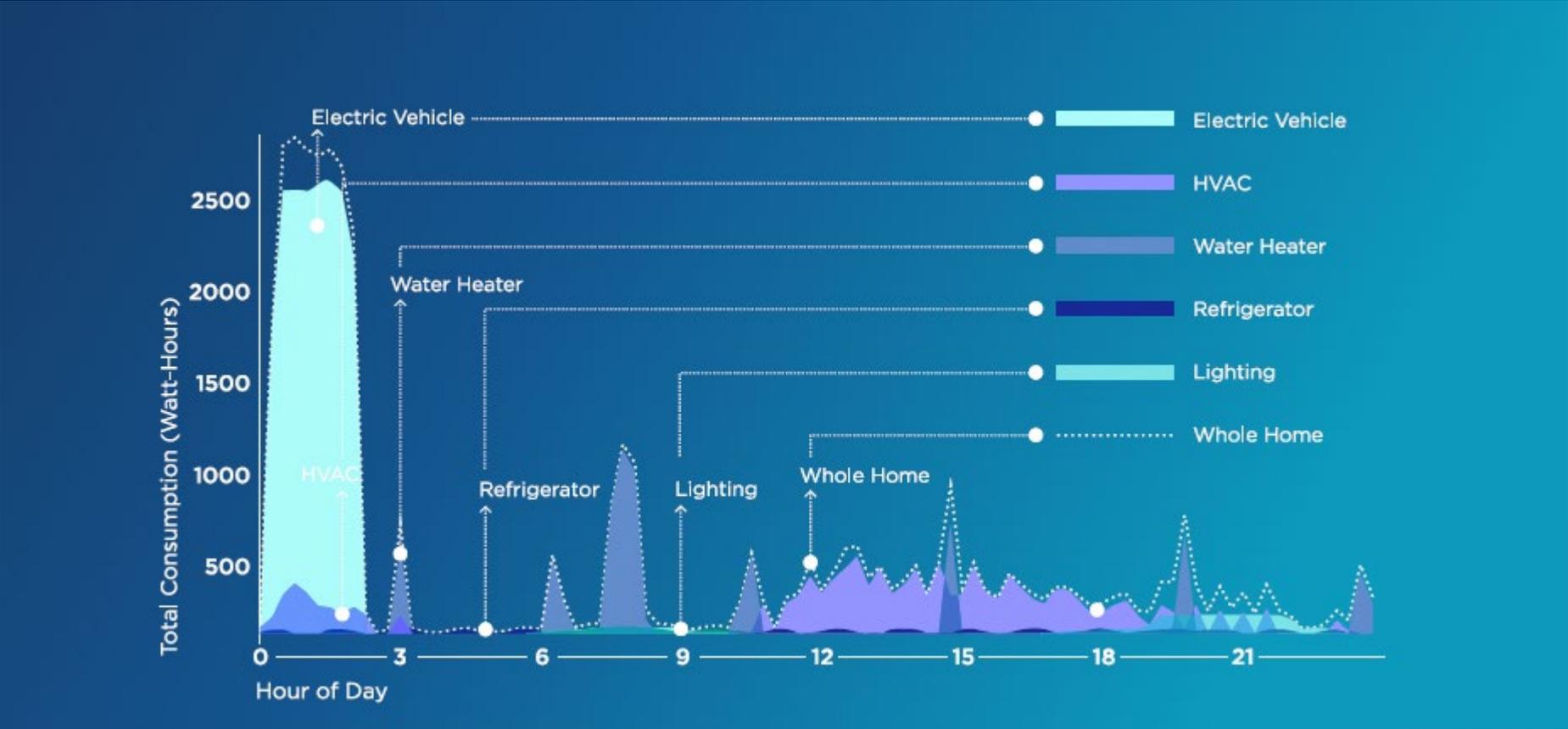
Energy Analytics – Why are they so important?

In actuality, energy analytics can identify inefficiencies that customers may not be aware of, such as an inefficient water-heater or air conditioner, enabling energy providers to educate and help customers with a right-fit service, rebate or program.

In addition to appliance and technology intelligence, applying sophisticated machine learning and statistical solutions to raw energy consumption data also reveals essential attributes that describe each customer's behavior, lifestyle, propensity to buy and other personal characteristics.

Energy Disaggregation and how to understand it.

Target ineffective devices and learn usage profiles



Energy Analytics – Customer Engagement

The image displays three smartphone screens illustrating customer engagement through energy analytics. Each screen is framed to look like a mobile phone with a white border and a drop shadow.

- Screen 1: WELCOME & ENROLLMENT**
 - Header: Energy Co., 700 Greenwood Court
 - Greeting: Hi Jonathan, Welcome to the Eligible EV Charging Program!
 - Text: You are now eligible to our new EV service for free. This service will help you monitor how much EV charging costs, and let you know when to charge to earn rewards, improve cost and environmental impacts.
 - Link: [View a look at the EV charging cost tool!](#)
 - Text: Did you know? You charged your EV at home for 50 hours last month.
 - Image: A white car charging at a station next to a calendar icon.
 - Text: You can track your EV charging at home by month, by day and even by hour.
 - Button: SEE MY HOURLY EV CHARGING
 - Links: [Learn how to use EV](#) | [Learn to charge my EV at home](#)
 - Text: To help you track your EV charging, you now have access to:
 - Your [hourly EV charging patterns](#)
 - Your [EV profile](#)
 - EV Peak Alerts whenever you charge between 3pm-5pm
 - EV Monthly Tracker email reports
- Screen 2: PEAK CHARGING ALERT**
 - Header: Energy Co., 700 Greenwood Court
 - Greeting: Hi Jonathan
 - Alert: ⚠️ EV Charged During Peak Hours
 - Text: It looks like you might have charged your EV during peak hours yesterday. This cost you \$6 more than if you had charged off-peak.
 - Image: A house with solar panels and a car charging.
 - Text: Remember to charge between 12am - 7am for the best rate.
 - Button: BROWSE OUR EV RATE PLANS
 - Text: Did you find this content in this email helpful?
 - Yes
 - No
 - Text: *All dollar amounts are rounded to the nearest dollar and represent actual electric usage. Monitor hourly charges, fees, and other services based on our rate schedule. This email was sent to: j.john@tantalus.com
- Screen 3: GAMIFICATION: MONTHLY SCORE**
 - Header: Energy Co., THIS IS NOT A BILL, PWD 033
 - Greeting: Hi Jonathan,
 - Text: You opted out 1 time last month (Nov). Great Job!
 - Text: Great job charging your EV during off-peak hours AND earning a \$20 credit last month. Keep it going this month. Remember peak hours are from 1 pm to 7 pm on weekdays!
 - Figure: A semi-circular gauge with a needle pointing to 'Good'. The gauge is divided into five segments: Excellent (0-1), Good (2), Fair (3), Poor (4), and Opt Out (5). The needle is positioned between 'Good' and 'Fair'.
 - Text: Here's How Everyone Else Did
 - Figure: A bar chart showing the percentage of users who opted out 0, 1, 2, 3, or 4+ times.

Opt Outs	Percentage
0	56%
1	21%
2	12%
3	8%
4+	3%
 - Text: OPT OUTS

HOMEOWNER APP

Allows homeowners to monitor their energy consumption, view usage history and activate energy saving modes.



POWER FLOW



LIVE CONSUMPTION & ENERGY INSIGHTS



TOP CONSUMERS

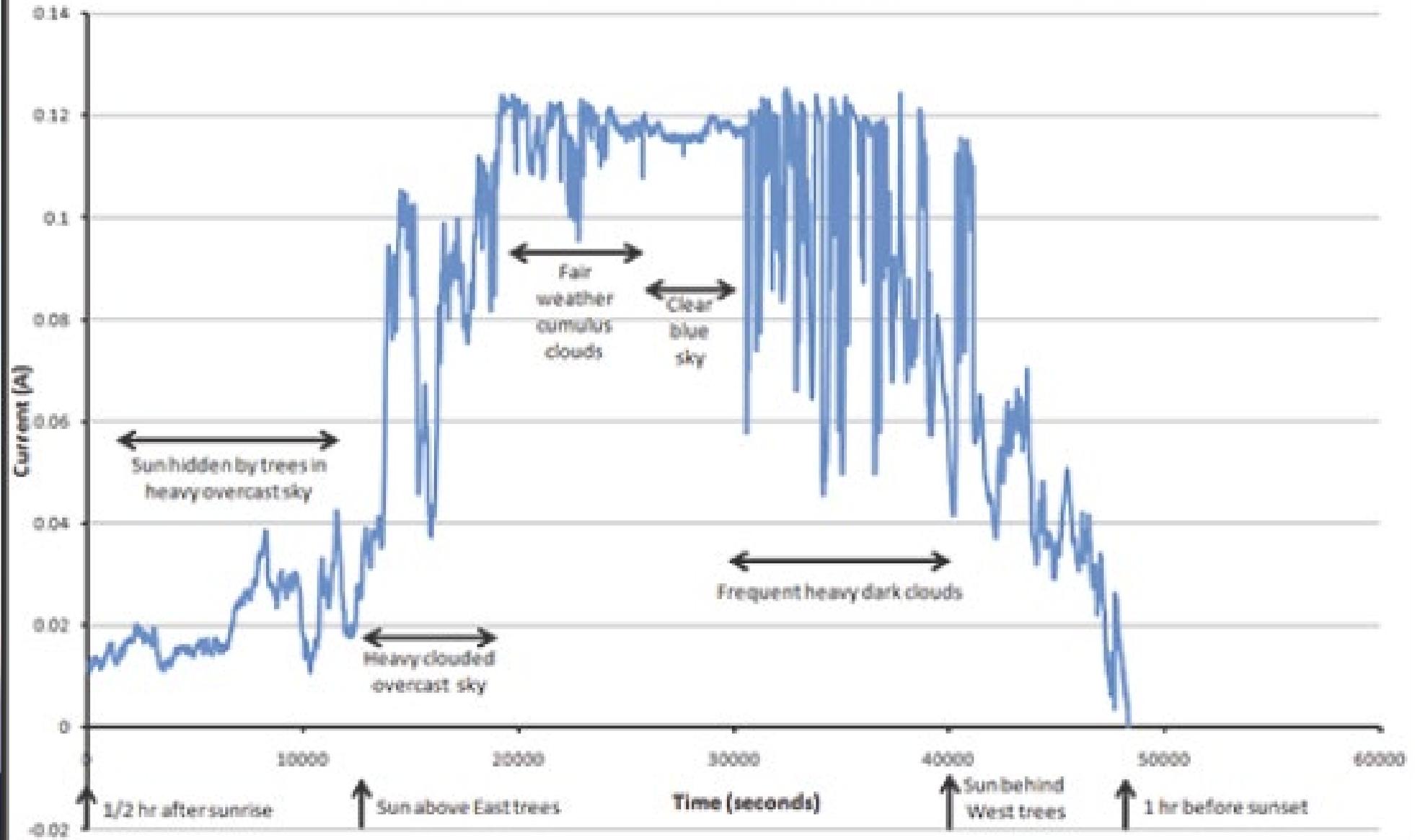


ENERGY HISTORY

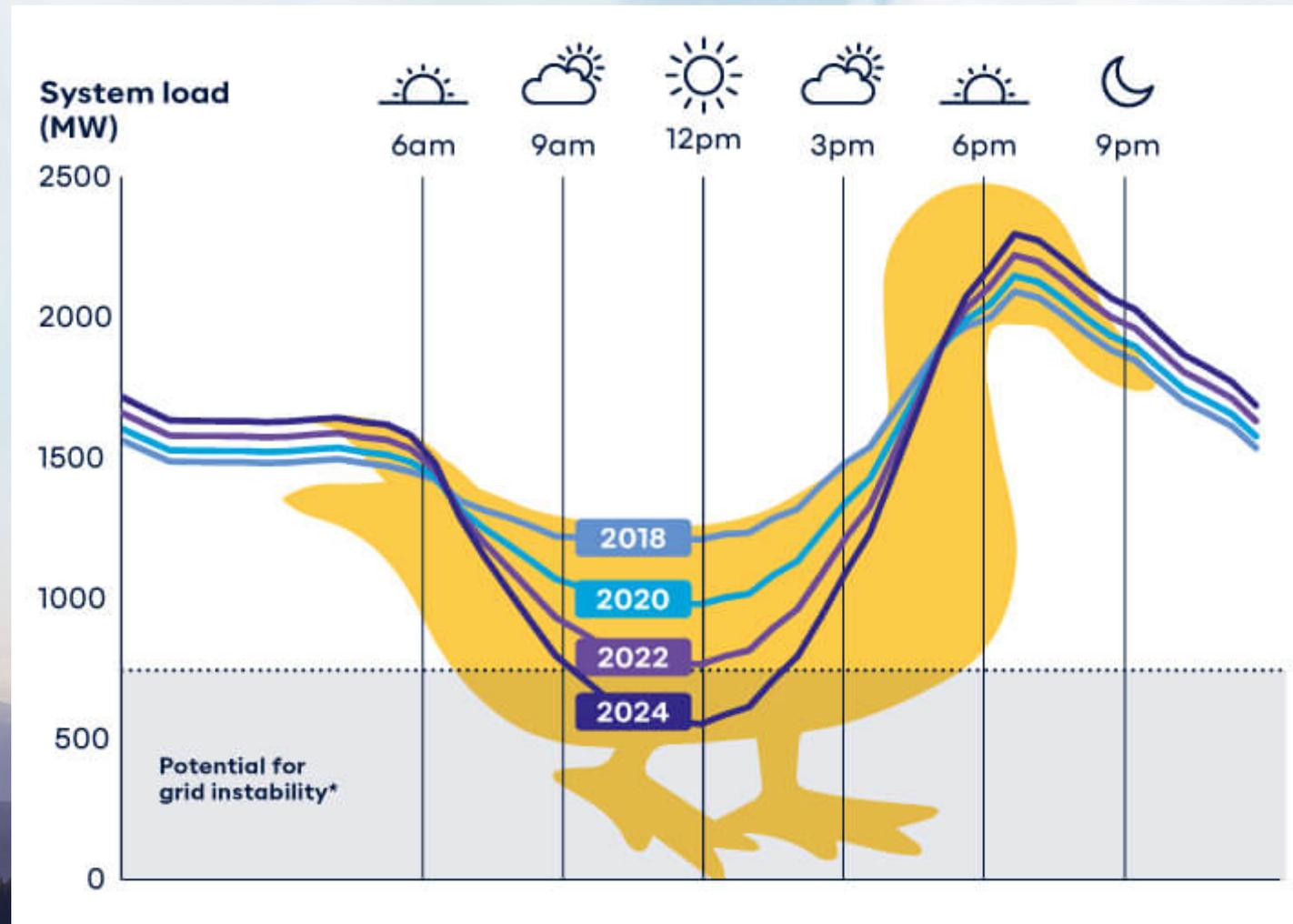
The Effect of DER's on the grid



The Effect of Sky Conditions on Solar Panel Power Output



Rooftop Solar – Stability Impacts



Strategic Energy Storage



ELECTRICITIES

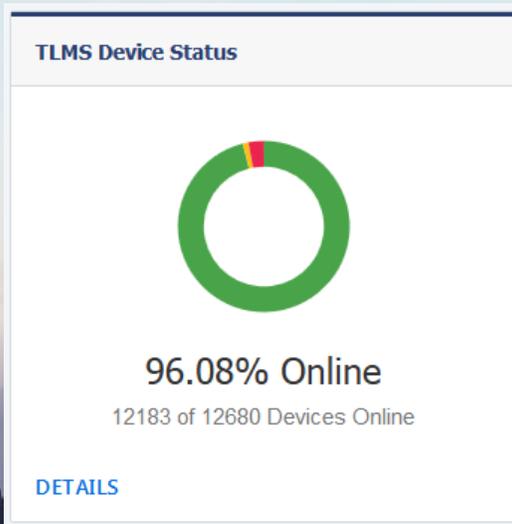
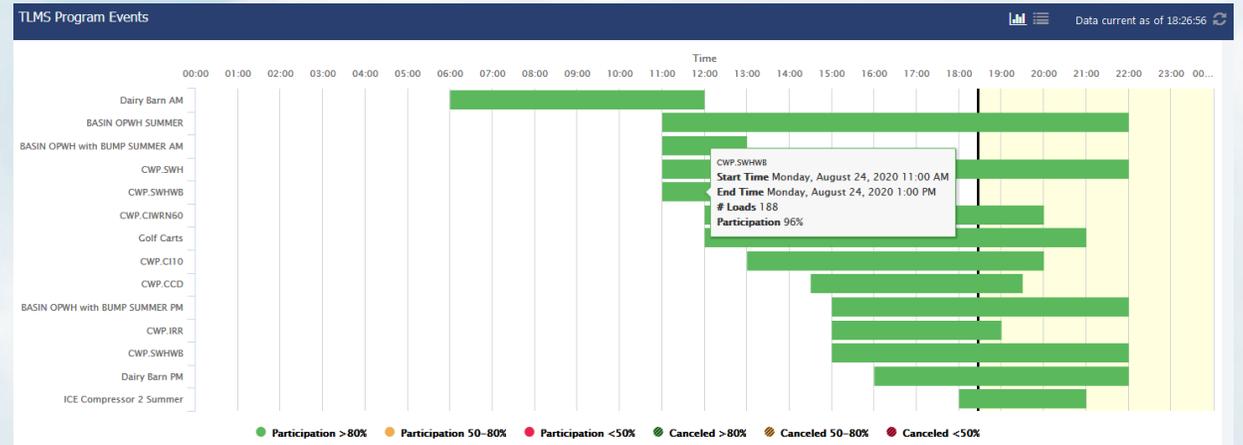
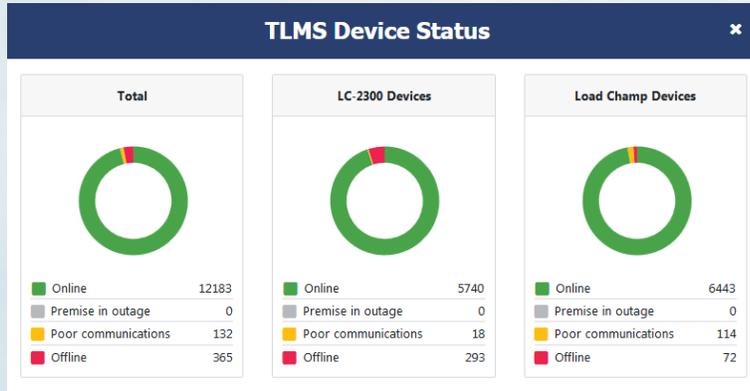
Confidential & Proprietary | **CONNECTIONS**



SUMMIT

2026

Dashboards to control load



Controlling the grid beyond feeders

Delivers the best experience possible...

- ✓ Vulnerable homes with medical equipment keep power
- ✓ Hospitals, emergency services keep power
- ✓ Water, municipal infrastructure keep power
- ✓ Streetlighting in high-crime areas keep power
- ⚡ All other customers do their fair share

And more ...

- ✓ Automated switching avoids truck rolls
- ✓ Fast adjustable response adapts with needs
- ✓ Precise control protects revenue
- ✓ Load ramping avoids problems with cold
- ⚡ More frequent power rotation for comfort and safety





The 4th Industrial Revolution is Analytics



2026 Connections Summit



tantalus.com, electricities.com, ncsu.edu



Andrew Mitchell amitchell@tantalus.com, Shawn Mankad <smankad@ncsu.edu>



TSX:GRID, OTCQX:TGMPF

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