

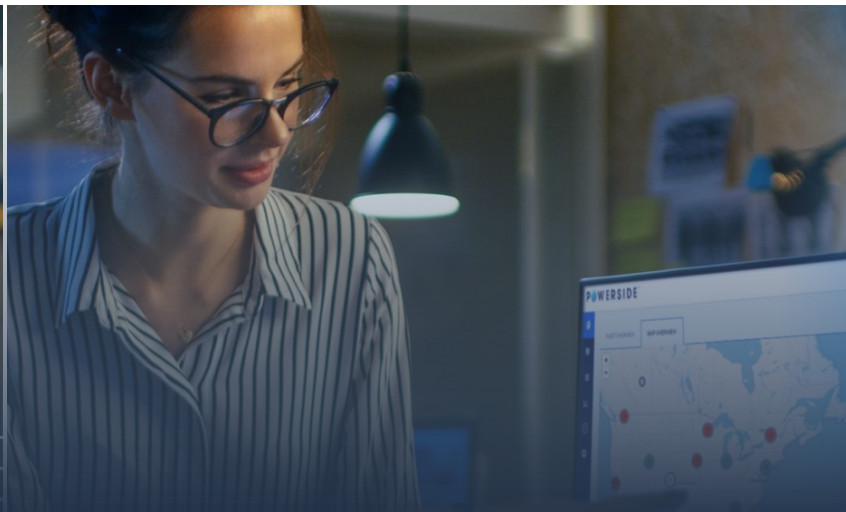


# Advanced Power Quality Analytics, PQView and the use of AI and ML techniques

– CEATI PQ Group

# Agenda

- 1 How PQView and Analytics fit in the Powerside Portfolio
- 2 PQ visibility and Access to Actionable Fleet Data.
- 3 Making value of the data - Reactive to Pro-active
- 4 Signature Recognition, AI and ML
- 5 Questions



# Company Overview, PQView and Analytics

# Company History – Power Quality Solution Provider for 75+ Years

## POWERSIDE®

- PSL & Power Survey merge in 2016
- Powerside acquires Electrotek - 2025



**Power Standards Labs – Founded in 2000**

- Power Quality Analyzers & Software
- Testing Services
- Manufactured in Alameda, California



**Electrotek Concepts – Founded in 1984**

- Power Quality Data Concentrator & Software
- On Premise, Vendor Agnostic Platform



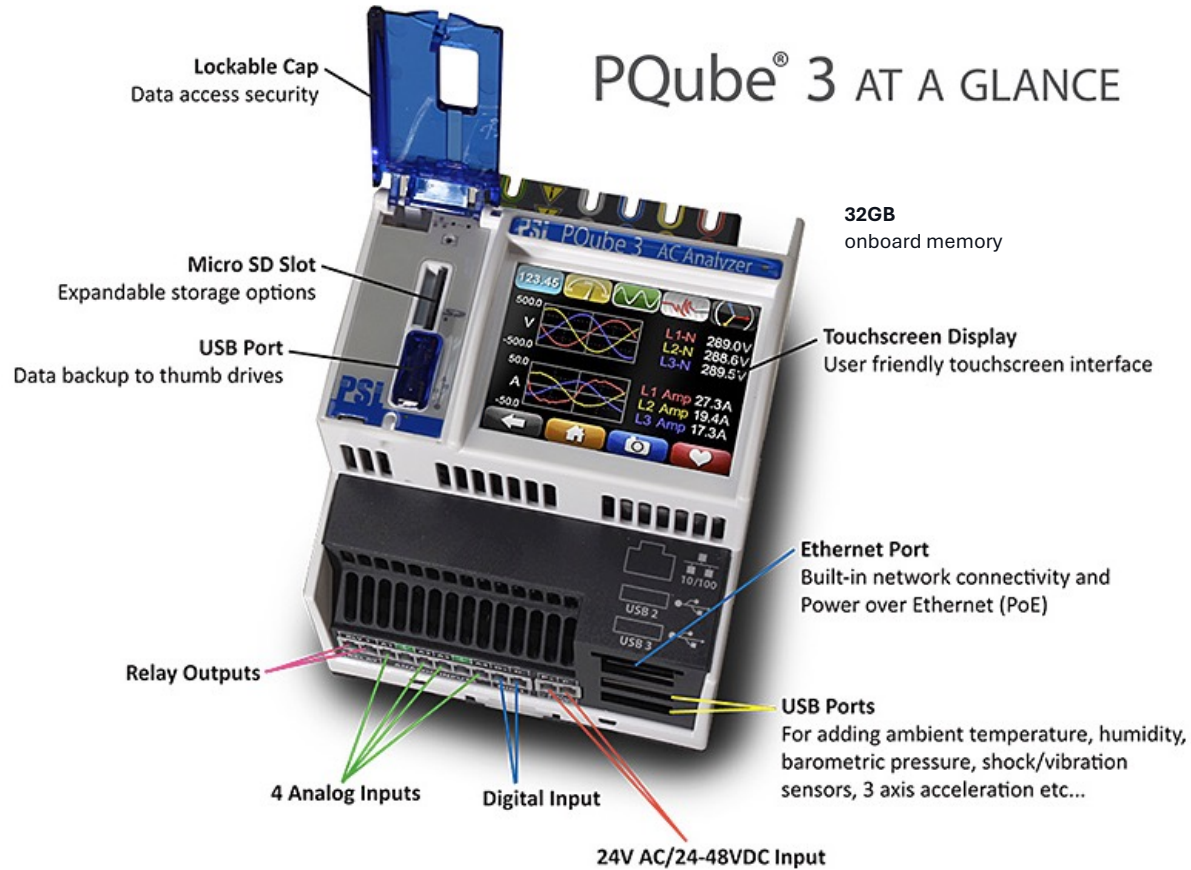
**Power Survey – Founded in 1948**

- Capacitor Banks & Harmonic Filters
- Power System Studies
- Manufactured in Montreal, Quebec

***Mission:** We apply our deep power quality expertise to help customers achieve exceptional visibility, reliability, and efficiency in their electrical systems. Through collaborative partnerships, we deliver solutions tailored to their needs.*

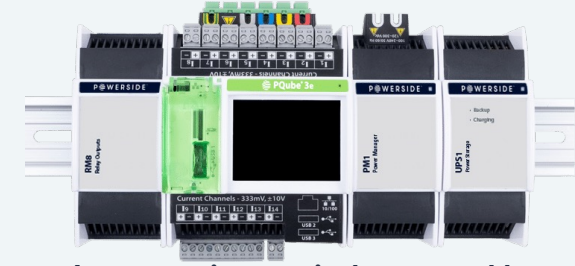
# PQ starts with permanently installed Class A hardware!

## PQube® 3 AT A GLANCE



**Combined Class A PQ monitor per IEC 61000-4-30 & 0.2 Class Power & Energy Meter per ANSI C12-20**

## Packaging Variations



**Din mount: Integrate into switchgear, ctrl house, etc.**



**Wall Mount Packages**



**Pole Mount Packages**



**Portable Packages**

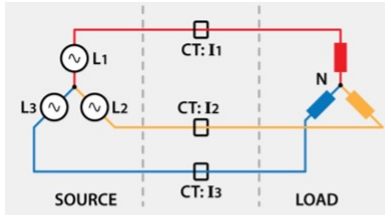


**Accessories & Sensors**

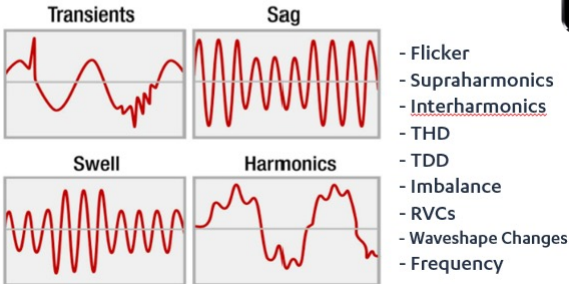
Check the live demo at:

**Web:** <http://demo.pqube3.com> or **Qubescan:** <http://cloud.powerside.com>

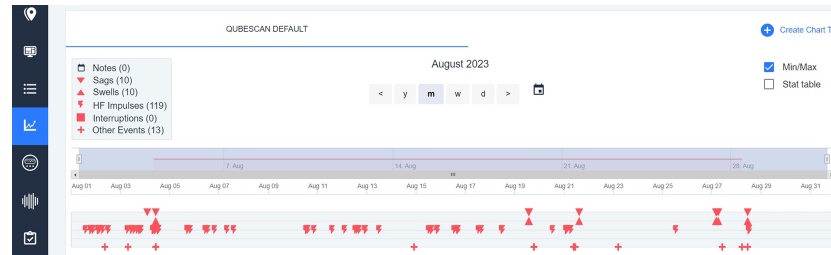
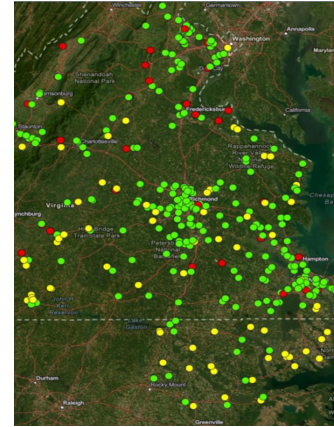
# Market shift from Solving to *Avoiding* Problems From PQ Issues



The Source & Load Define PQ



Power Quality Disturbances



PQ hardware & software solutions monitoring ~400 critical customers & DER 24/7

- Substations
- Solar Sites
- Data Centers
- Hospitals
- Industrials
- EV Charging
- Coop Delivery
- Microgrids
- Cogens

**Fleet-Wide Visibility:** Enables Situational Awareness – voltage compliance visibility & historian

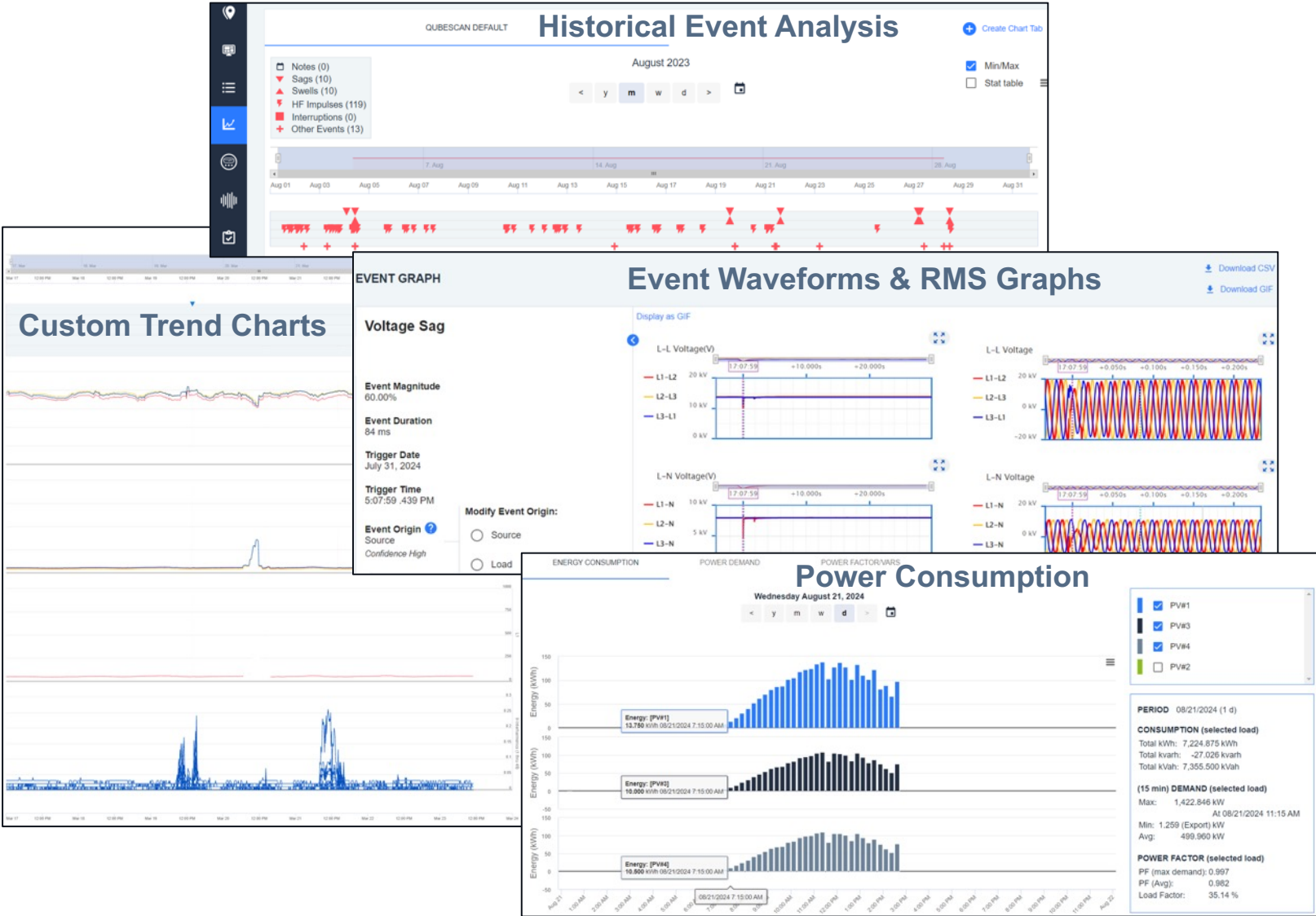
**Minimize Downtime:** Predictive Equipment Failure & Event Visibility for Faster Root Cause Analysis

**Continuous Compliance Visibility:** With Automated PQ Reporting. Non-Compliance = Threat to Reliability

**High Fidelity PQ Data Benefiting Other Depts:** Grid Planning Validating Models & Metering Using as an Energy Meter Backup

# Qubescan: Platform to Manage PQ Data, Alarms, & Analytics

- KEY QUBESCAN FEATURES**
- Real-Time Data Access**  
Monitor live power quality metrics for commissioning, diagnostics and real-time visibility
- Intuitive Dashboards**  
Visualize events, trends, power and energy disruptions with ease
- Custom Trend Alerts**  
Configure alarms to quickly identify power quality issues before they disrupt operations
- Automated Compliance Reports**  
Configure power quality reports on an automated, recurring basis for continuous health and compliance checks
- Fleet Disturbance Analytics**  
Proactively identify problematic circuits fleetwide or sites experiencing recurring disturbances
- Notification Center**  
Customize how you, your team and even external parties receive QubeScan notifications



# How to make better use of more data points and the best in Analytics & Reporting



**Powerful Data Concentrators:** Direct communication and data retrieval from many power measurement devices and systems.

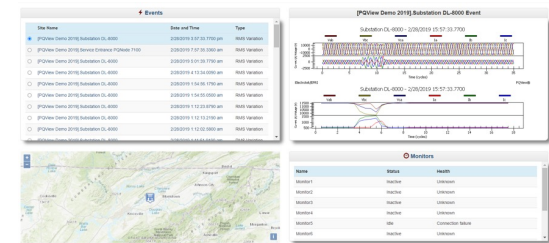
**Dashboard:** Quick overview of your system events and health.

**PQ Analysis Tools:** Provides insight and graphical views for the data collected.

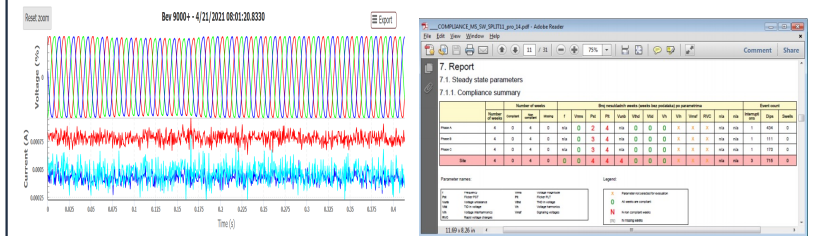
**Reporting tools:** Compliance reporting to meet customer needs.

**Fault Location:** Identifies fault and provides an accurate location to quickly solve the issue.

## User Experience

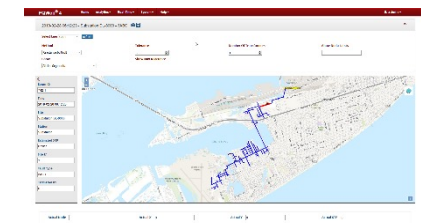


## Dashboard



## PQ Analysis

## Reporting Tool



## Fault Location

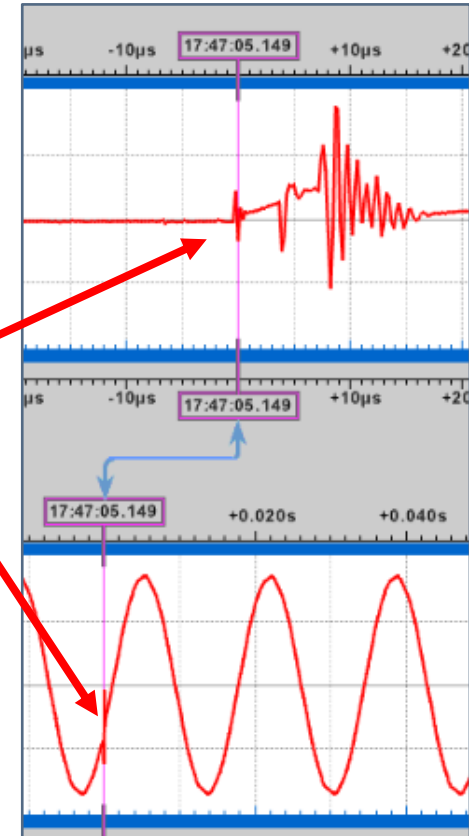
# From Reactive to Proactive Analytics

Proactive Maintenance Enabled by Detection of Fault Patterns

P  W E R S I D E <sup>TM</sup>

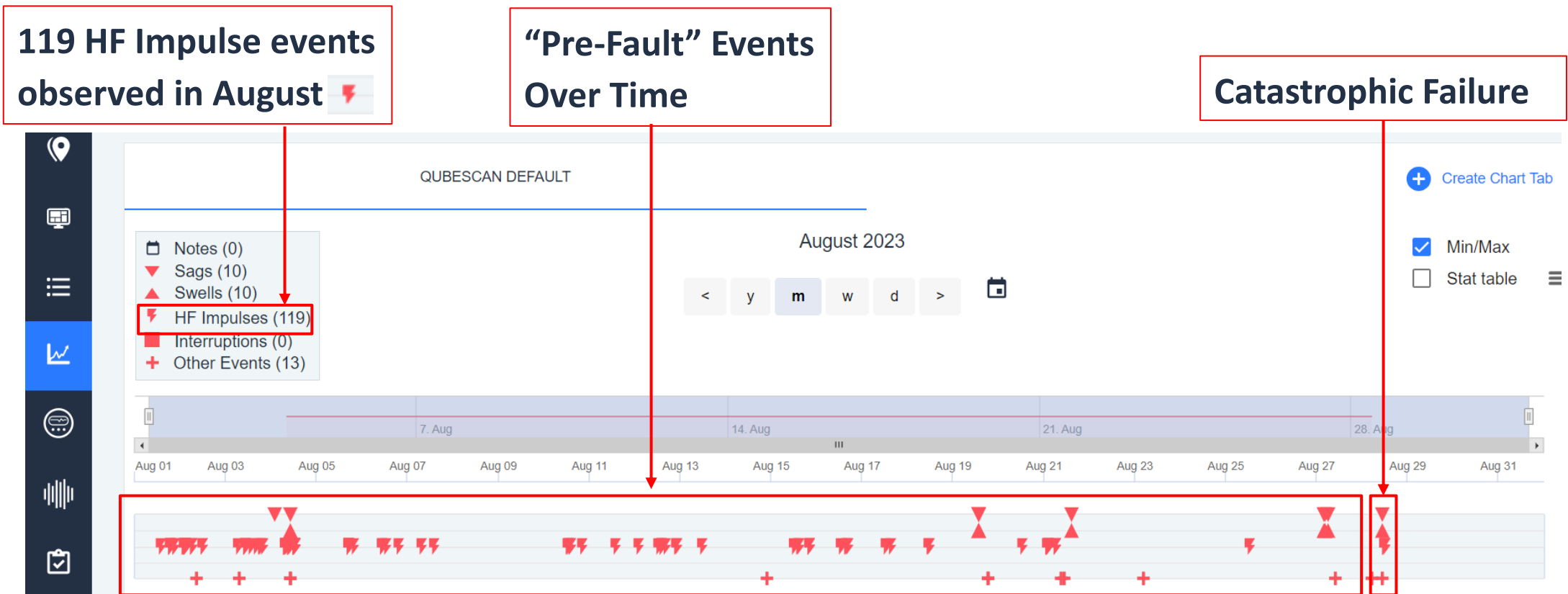
# High Frequency Impulse (Transients)

- Transient voltage trigger with high resolution 1MHz to 4MHz sampling rate
- Low magnitude incipient faults and higher magnitude transients
- HF impulse sources
  - Lightning
  - Switching (cap banks, reclosers)
  - PT issues
  - Energization
  - Poor neutral / ground connections



# Problem: Costly Maintenance and Outages from Catastrophic Failure

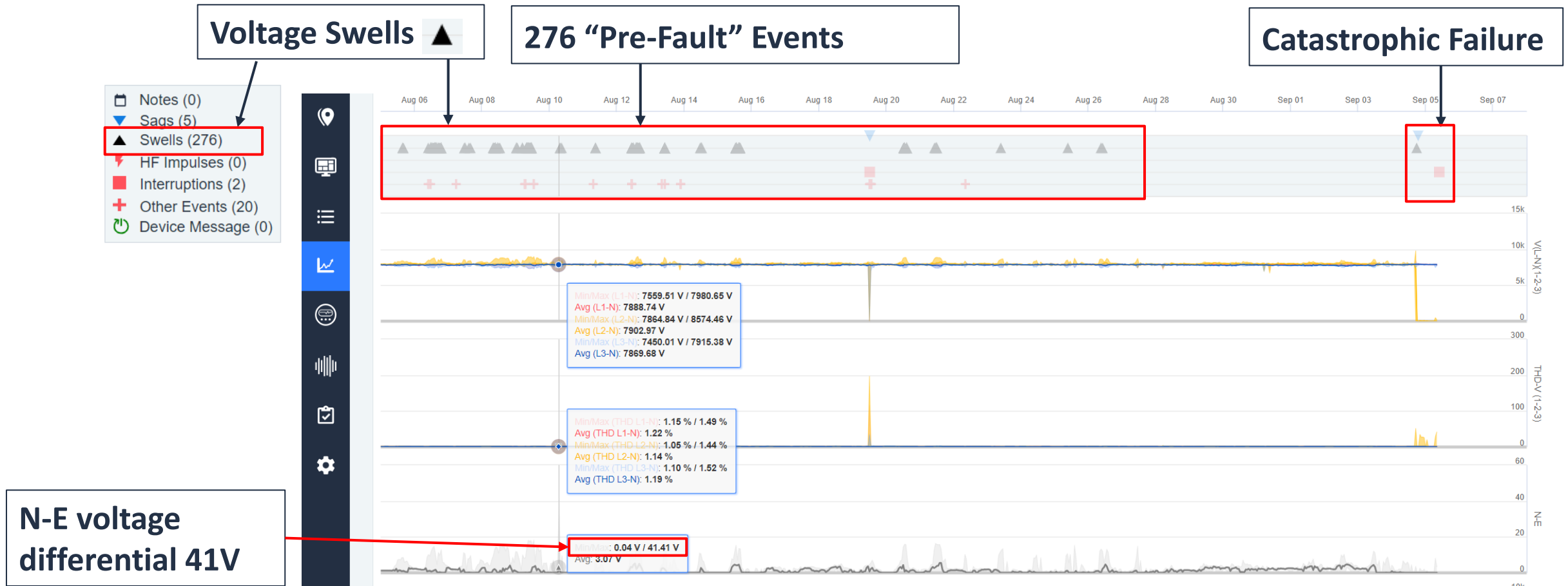
- High volume of events within 1-month lead to a catastrophic event
  - Events triggered on same phase, low magnitude, oscillatory in nature
- Identification of Fault Patterns enabled future avoidance of catastrophic failures



Cogen site monitoring PQ at primary metering VTs

# Problem: Voltage Swells Causing Catastrophic Failures

- High volume of recurring Voltage Swells lead to catastrophic failure
- Learning from actionable data allows for proactive future actions (preventative maintenance)



# Results: Proactive VT Replacement Program

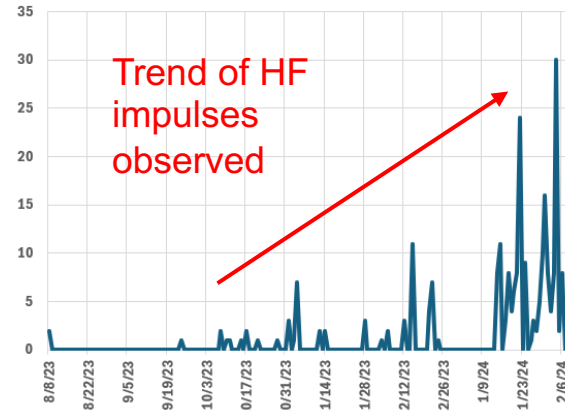
## Results:

Thousands of \$ saved in avoided outage costs, customer downtime, and disruptive efforts to isolate fault & restore power

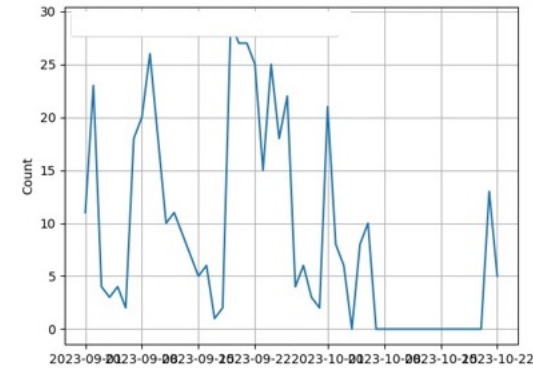
Proactive transformer replacements at these critical loads (preventative maintenance)

Potential outages mitigated

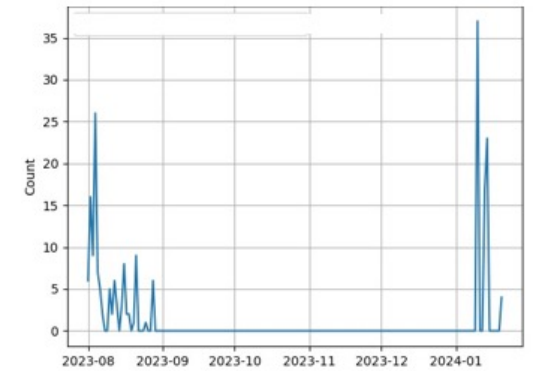
Biomass Plant



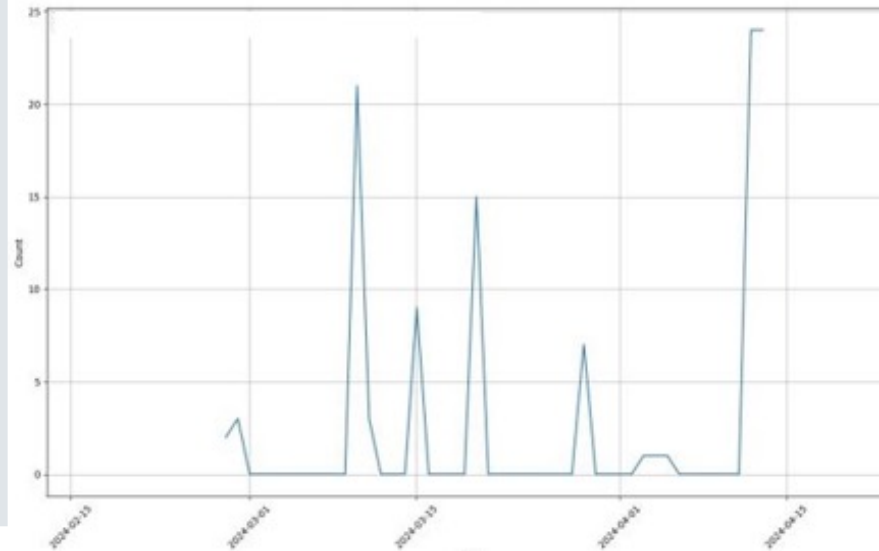
Data Center



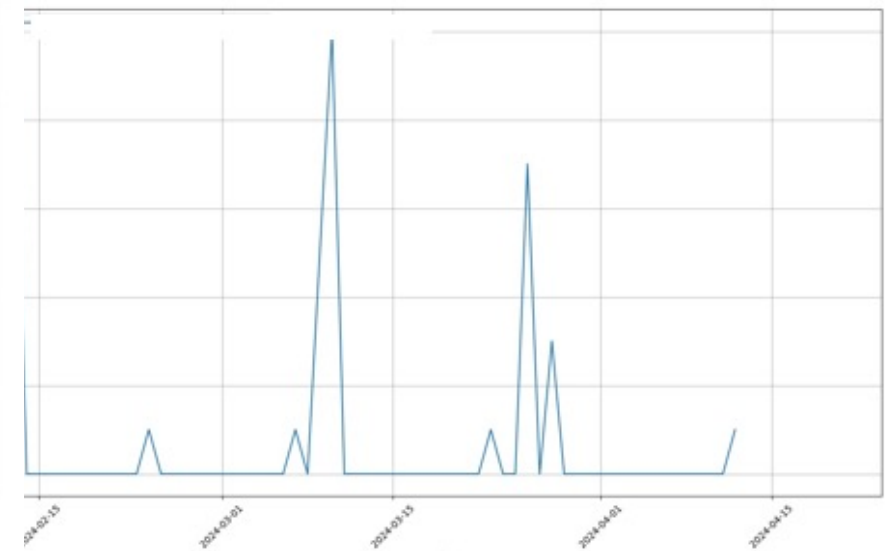
Cogen Site



Cogen Site



Industrial Site

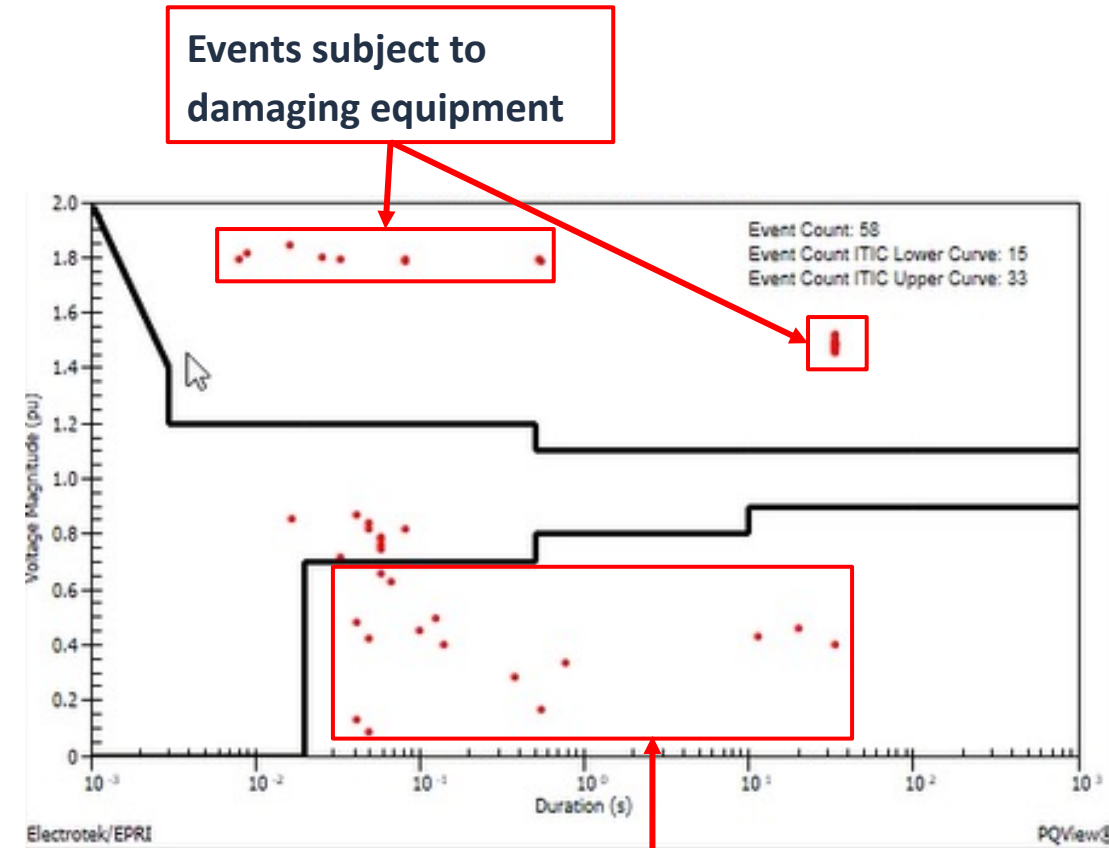


SARFI Monitoring – A further step to creating  
Customer Value from fleet data and being  
proactive

P  W E R S I D E <sup>TM</sup>

# SARFI – An Index that Further Defines True Customer Experience

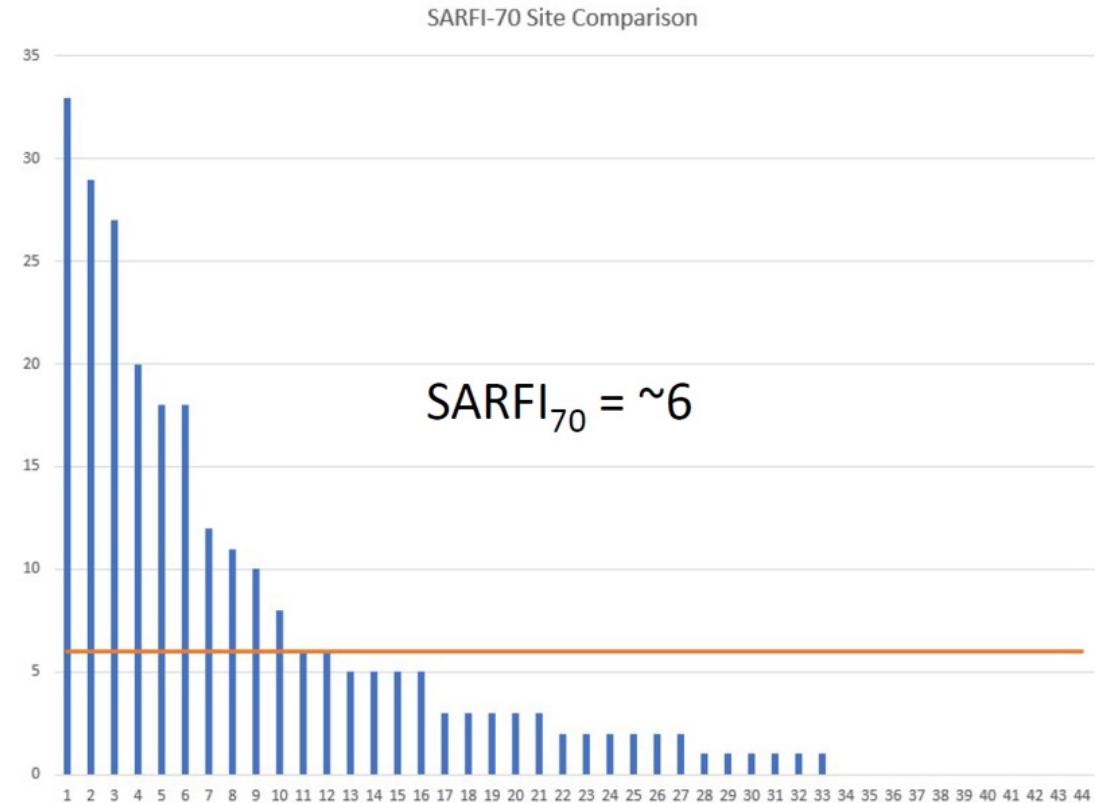
- How are you monitoring voltage issues? Customer Complaints?
- **S**ystem **A**verage **R**MS **F**requency **I**ndex Defined in IEEE 1564-2014 “IEEE Guide for Voltage Sag Indices”
- A count of voltage sags, interruptions, swells at a specified voltage magnitude/curve at a given site or system
  - SARFI<sub>CURVE</sub> observes events that violate boundaries of immunity curve
  - SARFI<sub>X</sub> observes voltage events that violate boundaries of a magnitude (defined by “X”)
- **Helps answer “How often does the Utility supply trip off the end user equipment & process?”**



**Impact on End Use Equipment:  
Example of SARFI<sub>ITIC</sub> Curve**

# SARFI Benefits – Comprehensive Insights to System Health

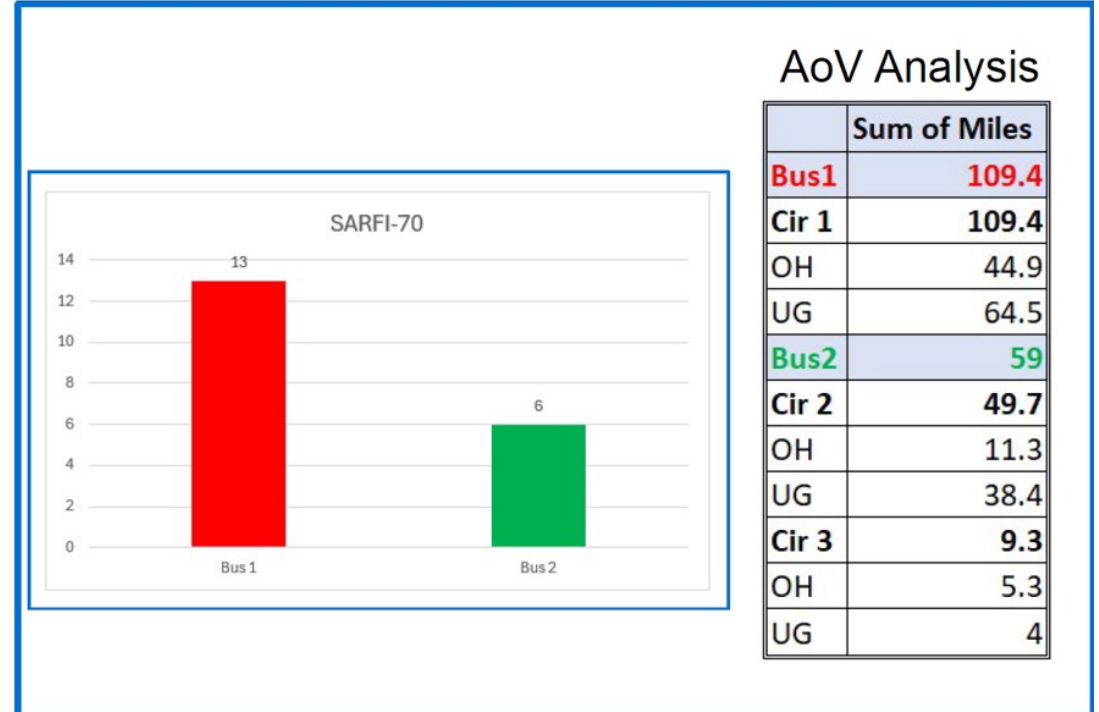
- Identifies active area “problem” circuits
  - Compare site to site performance
  - Compare performance by customer class / count
- Proactive correction of problem areas leads to Reliability gains
- Provides valuable insights
  - Customer impact & indicator on Utility support
  - Lost revenue at the customer & Utility
  - Planning & Design



**Site-to Site Performance Comparison:  
Identifying Vulnerable Areas**

# SARFI Use Case – Planning & Economic Development

- New Economic Development Dept investigating best path forward for energizing
- 27 MW load request near a substation with (2) buses to choose from
- SARFI<sub>70</sub> report used to assess reliability performance for prospective customer
- Bus 2 proved to have better performance and a better path forward





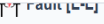

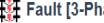







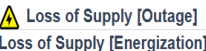












Using PQ Data for Effective Decision Making

# Signature recognition and automation










# Signature detection and categorization (labelling)

From technical signal triggers to operational insights ....

POWERSIDE   Grand Bahamas Power Company | RO80... Change Selection

|                                |  |                      |                       |   |
|--------------------------------|--|----------------------|-----------------------|---|
| 7:30:09 .992 AM                |  Fault [L-L]  | Voltage Sag          | M 75.00% - D 11ms     |    |
| 04/27/2026<br>6:02:16 .526 AM  |  Fault [3-Phase]  | Voltage Sag          | M 78.22% - D 300ms    |    |
| 04/22/2026<br>3:07:06 .731 AM  |  Fault [L-L]  | Voltage Sag          | M 84.11% - D 124ms    |    |
| 04/18/2026<br>5:34:14 .262 PM  |  Fault [3-Phase]  | Voltage Sag          | M 80.08% - D 954ms    |    |
| 04/15/2026<br>7:17:25 .140 AM  |  Loss of Supply [Outage]<br>Energization                  | Voltage Interruption | M 0.00% - D 4h 11m 5s |    |
| 04/15/2026<br>7:17:25 .048 AM  |  Loss of Supply [Outage]<br>Loss of Supply [Energization] | Voltage Sag          | M 0.00% - D 4h 11m 6s |    |
| 04/13/2026<br>3:57:15 .843 PM  |  Fault [L-L]  | Voltage Sag          | M 80.08% - D 75ms     |    |
| 04/13/2026<br>11:22:21 .509 AM | Sag/Swell [Pulsating Load   Deep Voltage Dip]  | Voltage Sag          | M 83.65% - D 82ms     |    |
| 04/12/2026<br>8:01:21 .612 PM  |  Load change [Pulsating Load]                             | Voltage Sag          | M 89.87% - D 25ms     |    |
| 04/07/2026<br>1:44:39 .898 PM  |  Load change [Load Increase]                             | Voltage Sag          | M 89.11% - D 33ms     |   |
| 04/03/2026<br>4:50:29 .853 AM  |  Load change [Load Drop]                                | Voltage Sag          | M 87.59% - D 16ms     |  |
| 04/02/2026<br>2:00:36 .965 PM  |  Load change [Pulsating Load]                           | Voltage Sag          | M 87.37% - D 17ms     |  |

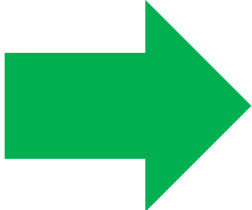
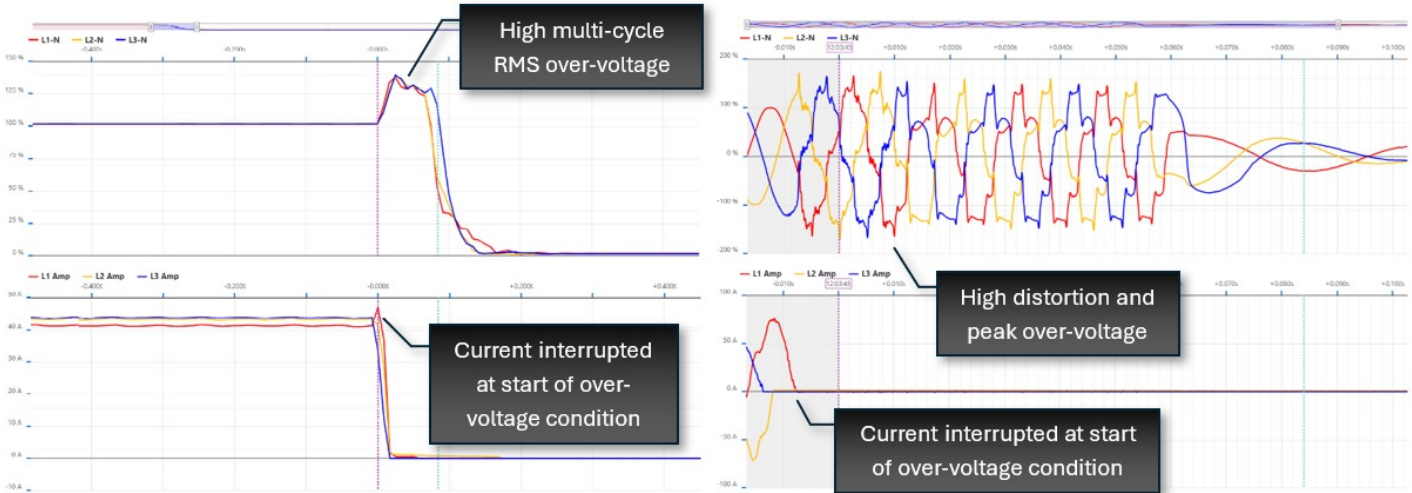
## Categories

|   |
|---|
|  Fault [L-G]                                   |
|  Fault [L-L]                                   |
|  Sag/Swell [Pulsating Load   Deep Voltage Dip] |
|  Fault [3-Phase]                               |
|  Motor Start [SoftSt or AcrossTL]              |
|  XFMR Inrush [Successful]                      |
|  Loss of Supply [Outage]<br>Energization      |
|  Loss of Supply [Outage]<br>Energization     |
| Load change [Pulsating Load]  |
|  Capacitor Switch                            |

# Signature detection and categorization (labelling)

Assessing severity of events (it is not just about ITIC....)

Example : severe over-voltage at initiation of an outage

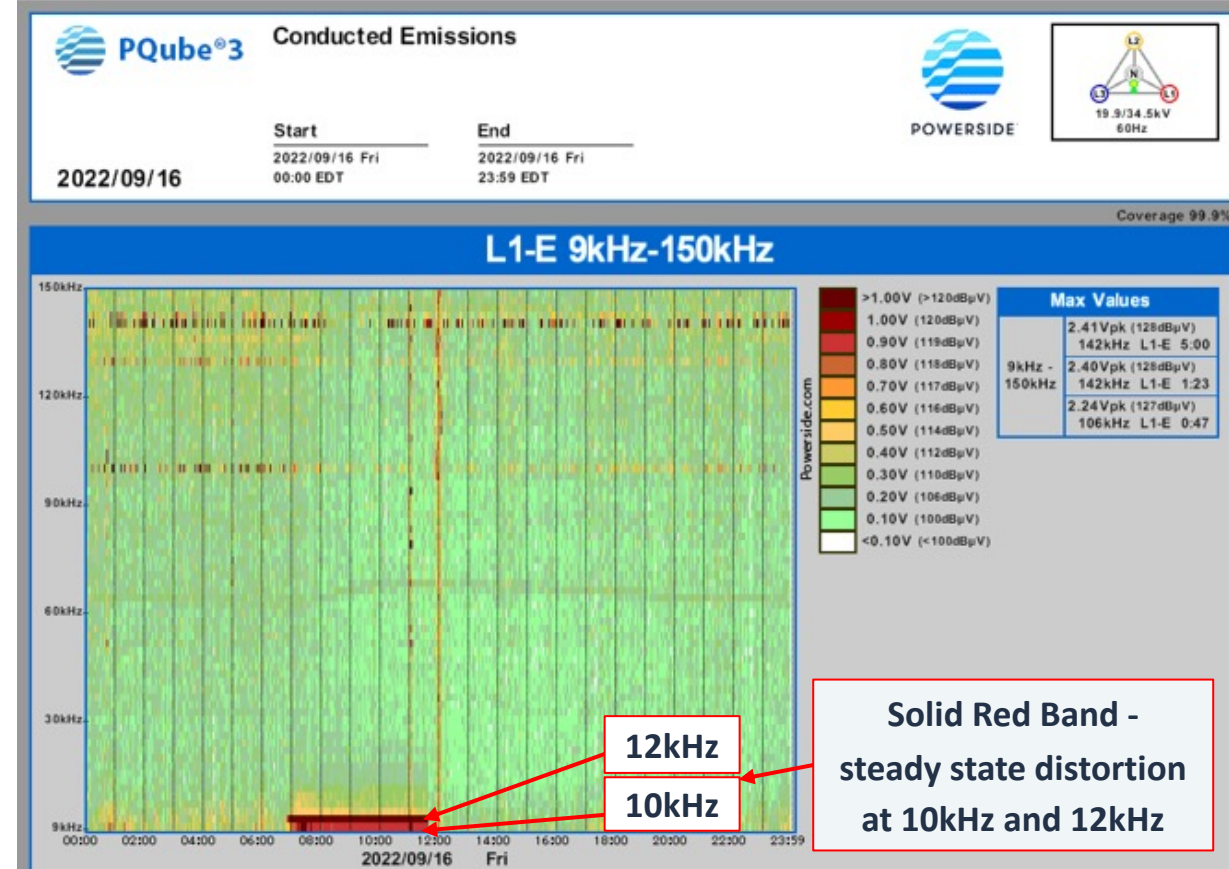


| Trigger Type   | Identification  |
|--|---|
| Voltage Swell<br>Site 3  | <b>Loss of Supply</b><br>Outage<br>Multi-cycle Over-Voltage [RMS,Peak,VTHD] |
| Event Magnitude<br>139.11%   | Severity<br>████████  |
| Event Duration<br>84 ms  | Current Saturation<br>No  |
| Event Origin<br>Unknown  | <b>Identification<br/>Cartouche</b>   |
| Trigger Date<br>November 18, 2024                                    |   |
| Trigger Time<br>12:03:45 .488 PM                                     |   |
| Trigger Channel<br>L1-N  |   |
| Event Labels ?<br><input type="text" value="Enter your label here"/> |   |
| Comments ?<br><input type="text" value="Enter your comment here"/>   |   |

# What Comes Next and how to use AI/ML?

# Steady State Conducted Emissions (Supraharmonics) Observed

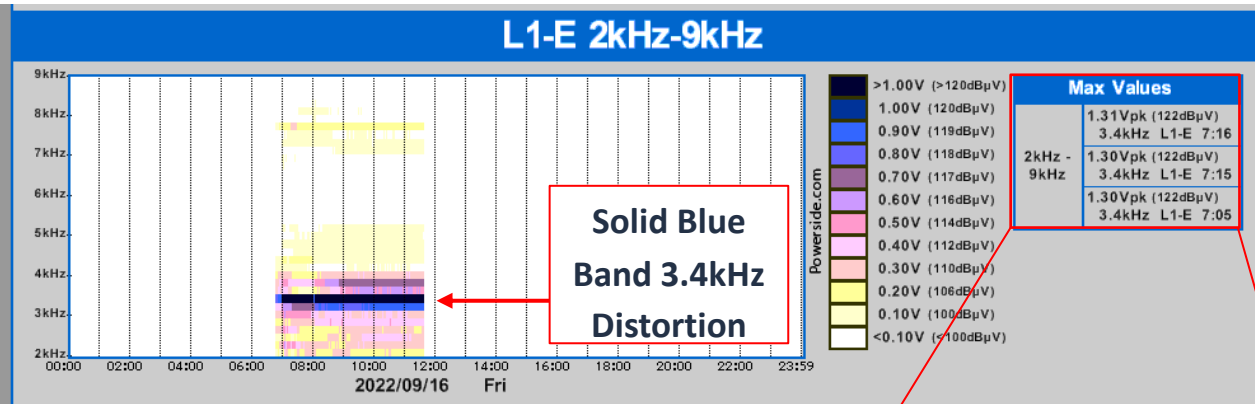
- Steady state distortion observed at 3.4kHz, 10kHz, 12kHz during reported complaint
- PQube data shared with inverter manufacturer for evaluation
- Corrective Action: Inverter manufacturer developed FW update - pulse shifting switching frequency**
- No further customer complaints reported



Steady State Supraharmonics at 10kHz & 12kHz

Solid Red Band - steady state distortion at 10kHz and 12kHz

12kHz  
10kHz



Steady State Supraharmonics at 3.4kHz

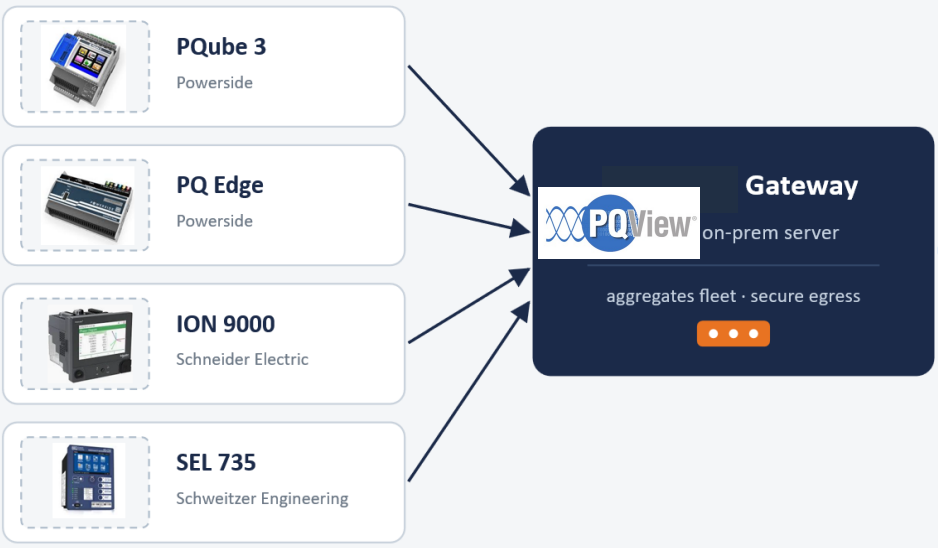
Solid Blue Band 3.4kHz Distortion

1.3Vpk distortion @ 3.4kHz  
Note: Values >1V are problematic

| Max Values |                   |
|------------|-------------------|
|            | 1.31Vpk (122dBμV) |
|            | 3.4kHz L1-E 7:16  |
| 2kHz -     | 1.30Vpk (122dBμV) |
| 9kHz       | 3.4kHz L1-E 7:15  |
|            | 1.30Vpk (122dBμV) |
|            | 3.4kHz L1-E 7:05  |

# Hybrid platform – the best of both worlds to get data

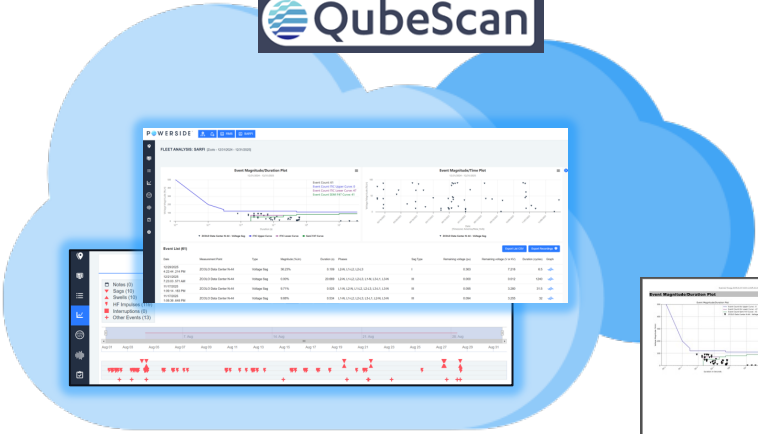
## On-premise perimeter



Single secured outbound path to the Internet



## Cloud platform

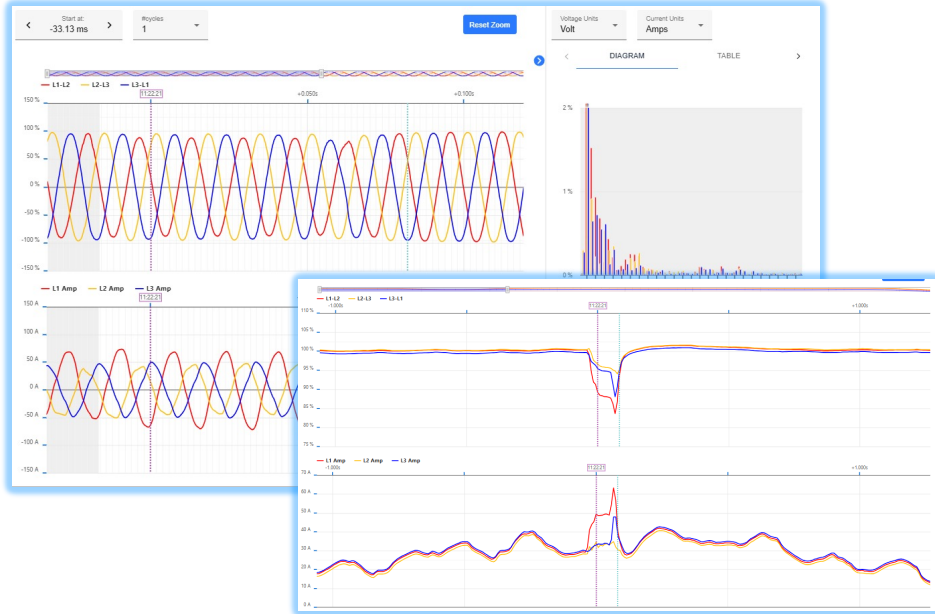


- . Alerts & actionable insights
- . AI assistant
- . Overview Dashboards
- . Reports ...

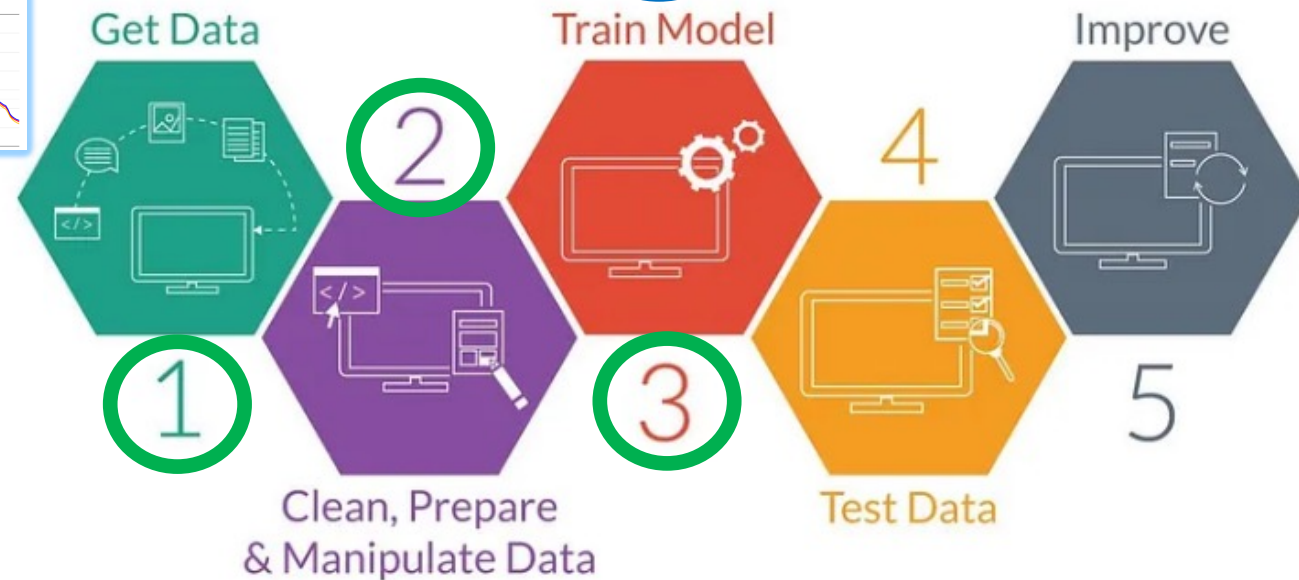
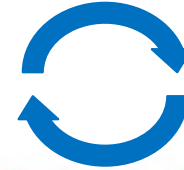


# The automation of Signature recognition (Machine Learning)

Source: 1500+ Measurement Points, several years



Power & PQ Experts



# Conclusion

# Summary & Key Takeaways

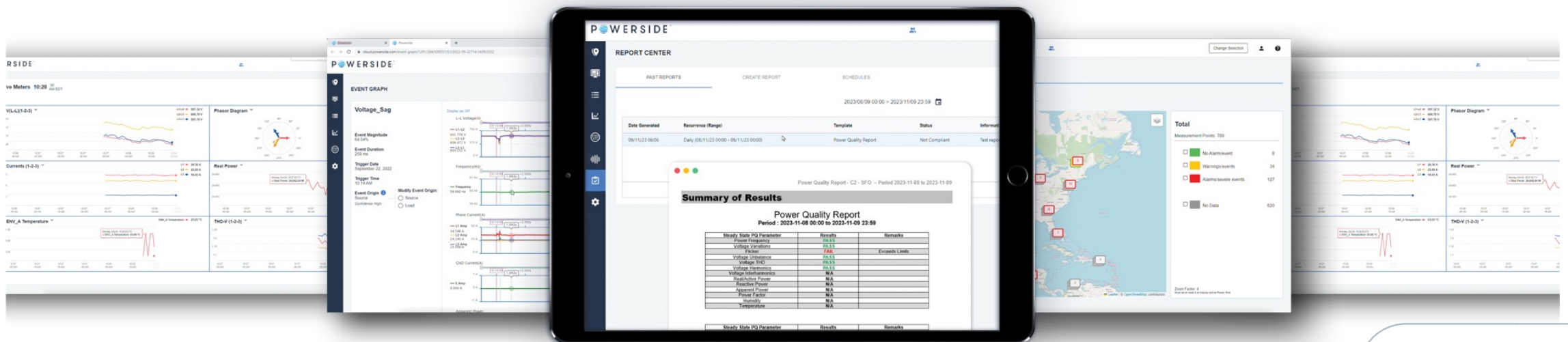
Today's power grid is transitioning to a digital, decarbonized, and decentralized system, creating a more vulnerable, dynamic grid landscape

Continuous PQ monitoring visibility empowers grid reliability and mitigating disturbances & outages but the data needs to be used as a predictor not simply for analysis post event.

Case studies utilizing PQ platforms demonstrate enabling actionable information & ROI via:

- Alarm notifications
- Compliance
- Validating Grid Models
- Fleet-wide analytics
- Enhanced Customer Service through Cooperation

Work has begun on signature recognition to further enable data categorization whilst protecting data security.



# Thank You!

# Questions?

[sales@powerside.com](mailto:sales@powerside.com)