Getting more out of your Operational Data

Leveraging Operational Data, Spatial Intelligence, and AI to Enhance Grid Reliability

Tue, June 11, 8:00am – 8:50am

Paul Bower

Southwire®
Digital Solutions

Paul Bower has over 30 years of experience in the utility industry; developing software solutions for Outage Management, AMI, and Operational Business Intelligence. He is currently the Director of Data Engineering at Southwire's Digital Solutions group, focused on delivering Data Science driven Grid Resiliency solutions spanning asset modernization, asset improvement, and vegetation optimization. Mr. Bower holds B.S. degrees in Computer Science and Mathematics.

GETTING MORE OUT OF YOUR OPERATIONAL DATA

This session will delve into how a synergistic relationship between disparate data, spatial intelligence, and artificial intelligence is used to prioritize cost-effective remedies for enhancing grid reliability.

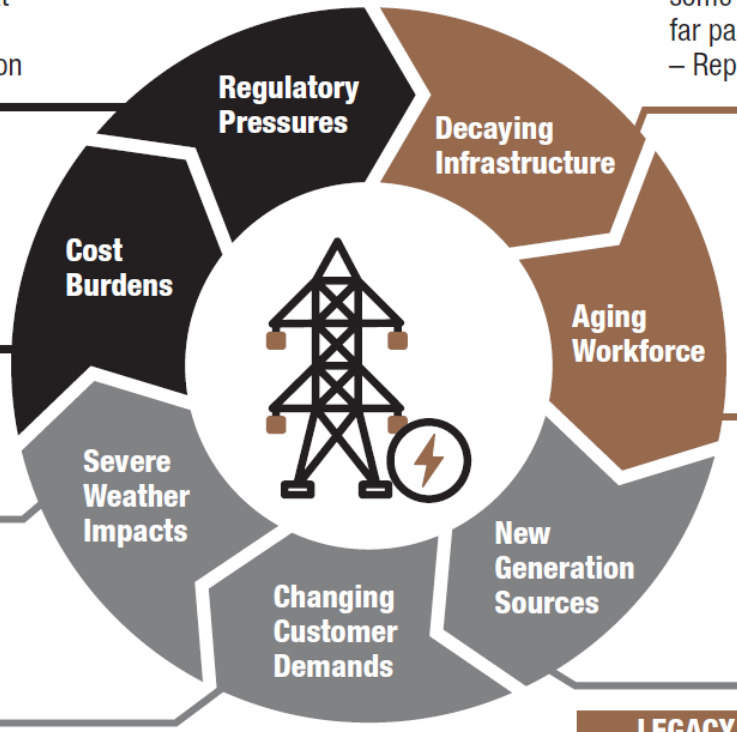
UTILITIES ARE FACING A CONFLUENCE OF PRESSURES TO IMPROVE GRID RELIABILITY

"Performance-based regulation is regulation in which anyone can know how good utilities are at delivering on clearly stated expectations"
– Next-Generation Performance-Based Regulation

"Utilities are requesting rate increases in growing magnitude as the industry moves toward a clean energy economy, adopts new technology and replaces aging infrastructure"
- S&P, 2022

51% of utilities say extreme weather events have affected reliability of electricity delivery
- Deloitte, 2022

EV adoption is set to grow from about 2% of the fleet today to up to 15% by 2030
– PwC, 2021



"The majority of the nation's grid is aging, with some components over a century old – far past their 50-year life expectancy"
– Report Card for America's Infrastructure, 2021

"Turnover is already relatively high, made more urgent by an aging workforce approaching retirement"
– KPMG, 2022

"The grid faces increasing pressure to integrate new technologies - such as EV's, distributed solar generation and energy storage - in a rapid, safe, and low-cost way"
– McKinsey, 2020

LEGACY | EMERGING | MACRO

GETTING MORE OUT OF YOUR OPERATIONAL DATA

By leveraging disparate data, spatial intelligence and AI, utilities can navigate the complexity of grid improvement options and make informed, cost-effective decisions to bolster reliability, benefiting the utility and, ultimately, the customer.

Grid reliability improvement landscape

Equipment Modernization

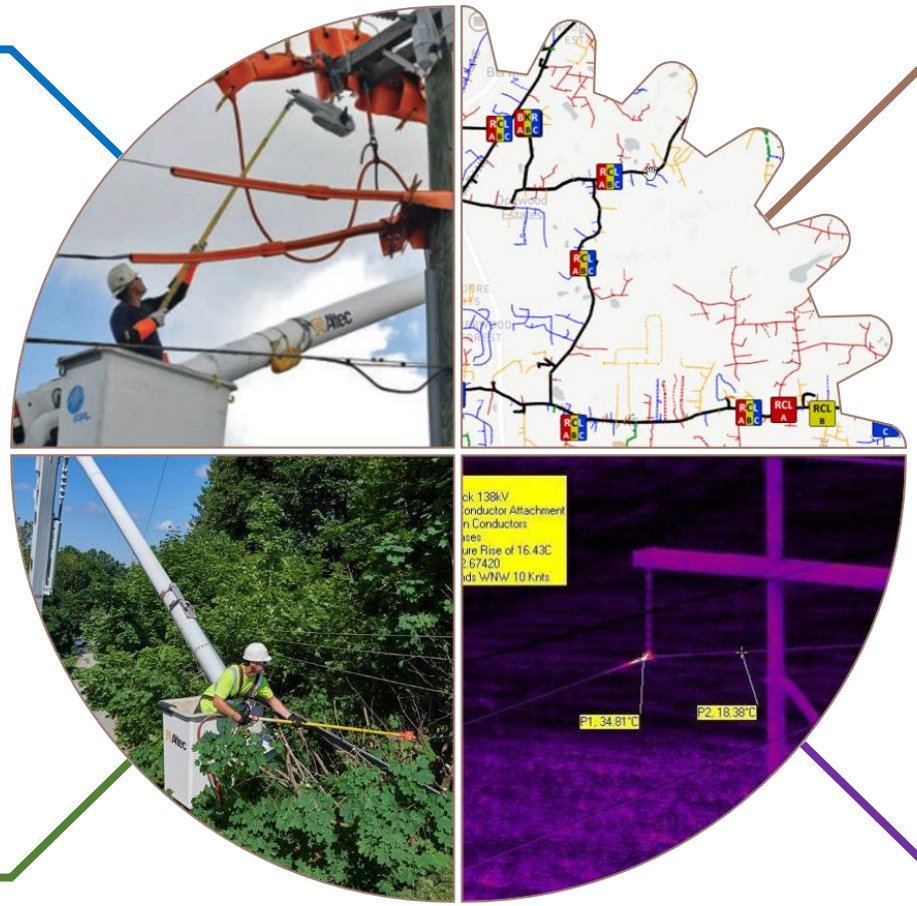
When and where to modernize equipment?

- Identify equipment and wire upgrades
- Reduce sustained outages by eliminating transient events
- Install new smart grid technologies

Network Optimization

When and where to optimize equipment?

- Resolve phase balance issues
- Resolve Miscoordination
- Segment long circuit sections
- Protect unprotected laterals



Vegetation Management

When and where to mitigate vegetation?

- Transition from cycle-based work to condition based work
- Mitigate fire risk
- Reduce storm restoration time

Asset Improvement

When and where to improve assets?

- Mitigate defects
- Strengthen the grid
- Weather and climate resistance

What makes prioritizing solutions for improving grid resiliency so complex?

The sheer complexity of the underlying pieces…

- ✗ **Distributed assets** make it difficult to track and resolve issues
- ✗ **Disconnected applications** only solve single use cases
- ✗ **Disparate data** is unstructured and complex

▼

Difficult and time consuming to perform root cause and effect analysis

…stretches the capacity of your in-house team

- ✗ **Limited resources** means firefighting instead of focusing on strategic value
- ✗ **Long time** to project completion
- ✗ **Lack of access** to consolidated industry knowledge

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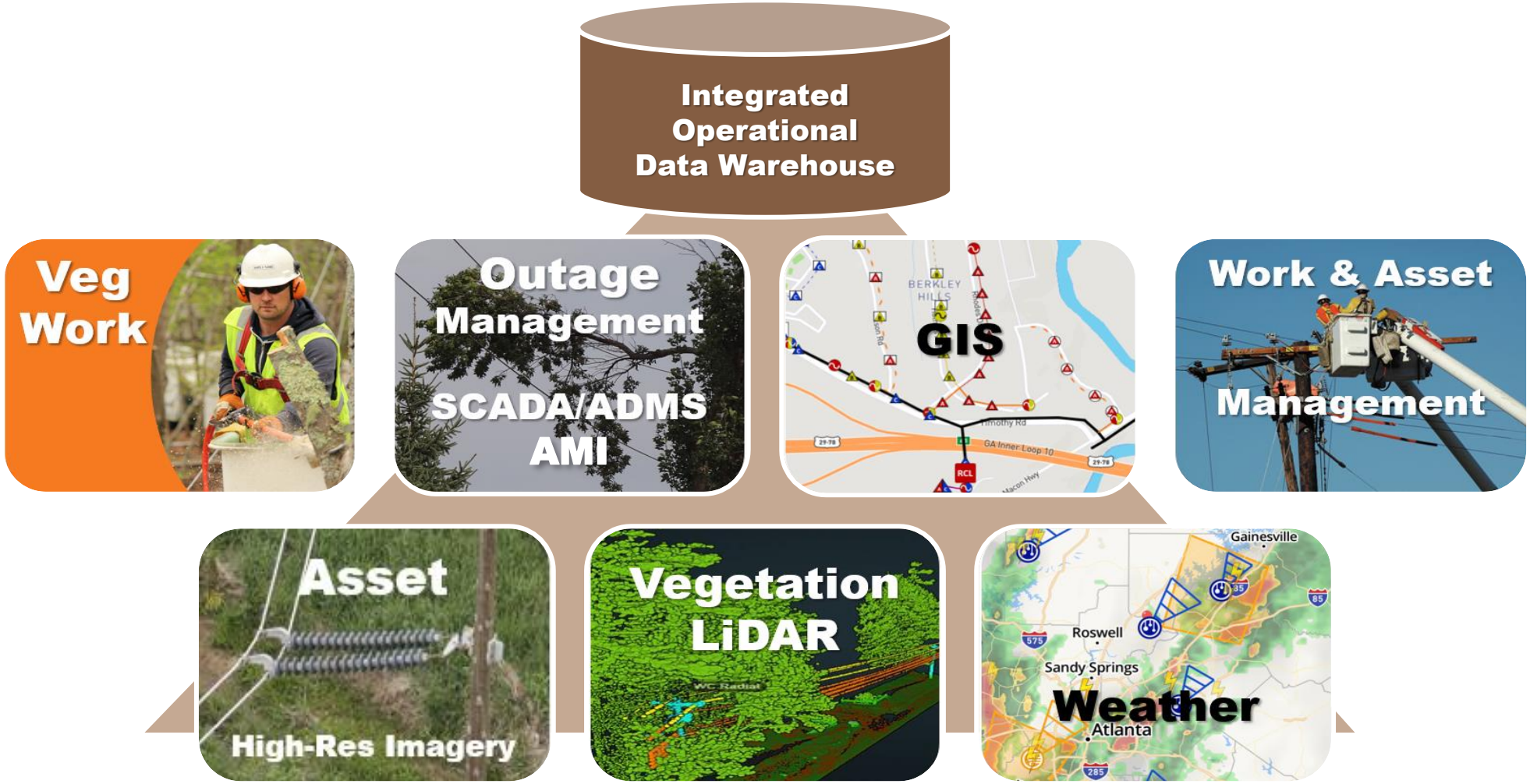
Challenging to continually leverage new information and grid technology

By leveraging disparate data, spatial intelligence, and AI we can solve this problem.

*Advanced analytics **integrate disparate data**, uses spatial intelligence, and AI to make recommendations.*



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CHALLENGES

- Obtaining Operational Data for a 5-year window, longer if available
  - Outage management systems may have changed
  - Data elements can change over time – cause codes, failure codes, etc..
  - Related outage equipment may be changed out; fuses to reclosers, overhead wire undergrounded, etc..
- GIS is primarily a current as-built state
  - Missing data; install dates, equipment models, etc..
  - Device/equipment change outs may not be documented.
- Obtaining Current and Prior year hourly kWh Usage, Voltage, or other values.
  - Data gaps due to Outages or AMI issues need to be addressed for correct hourly consumption values.
  - Allocation of usage where reads are more frequent or less frequent than hourly.
  - Aligning AMI data with momentary and sustained outages and network topology to support .
- The solution requires data validation to “true up” the data

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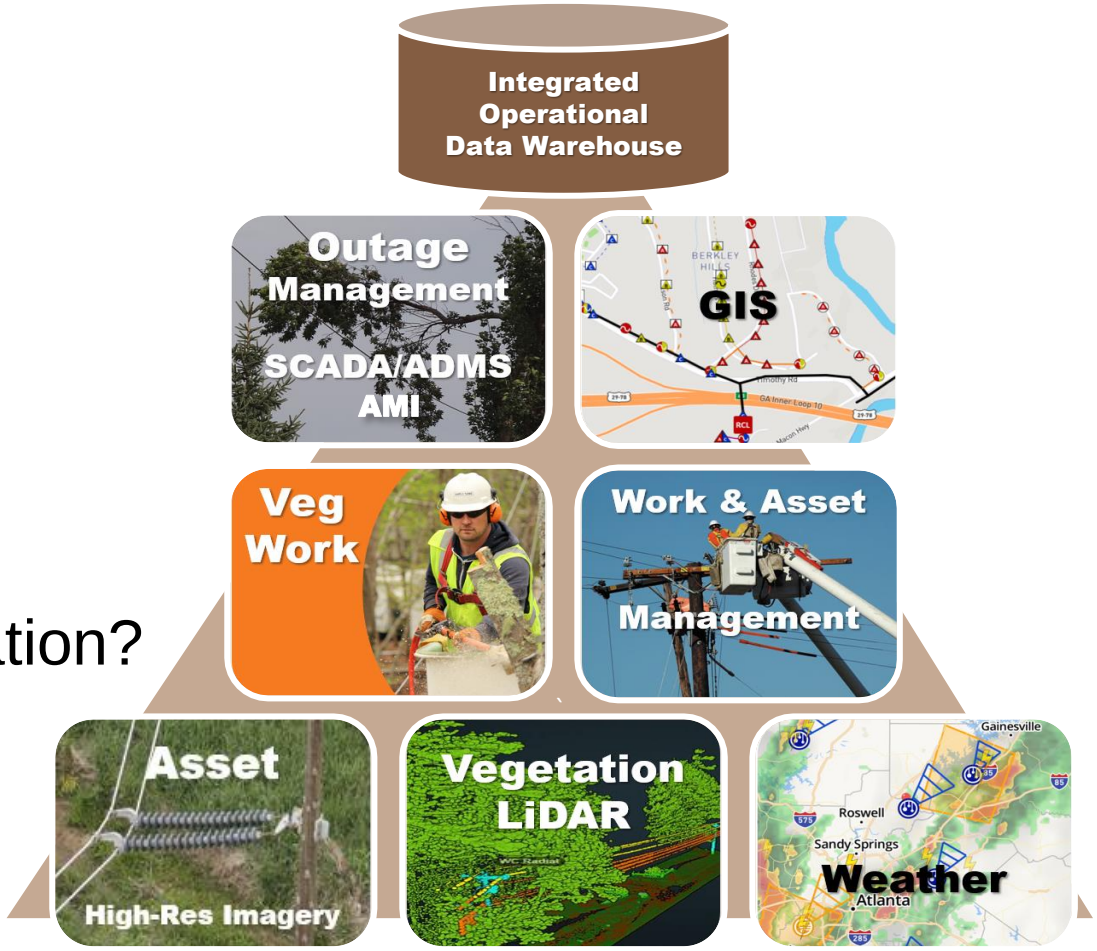
Obtain OMS Data for a 5+ year window of time along with 2 years of AMI data if available

Perform Data Validation and Cleansing

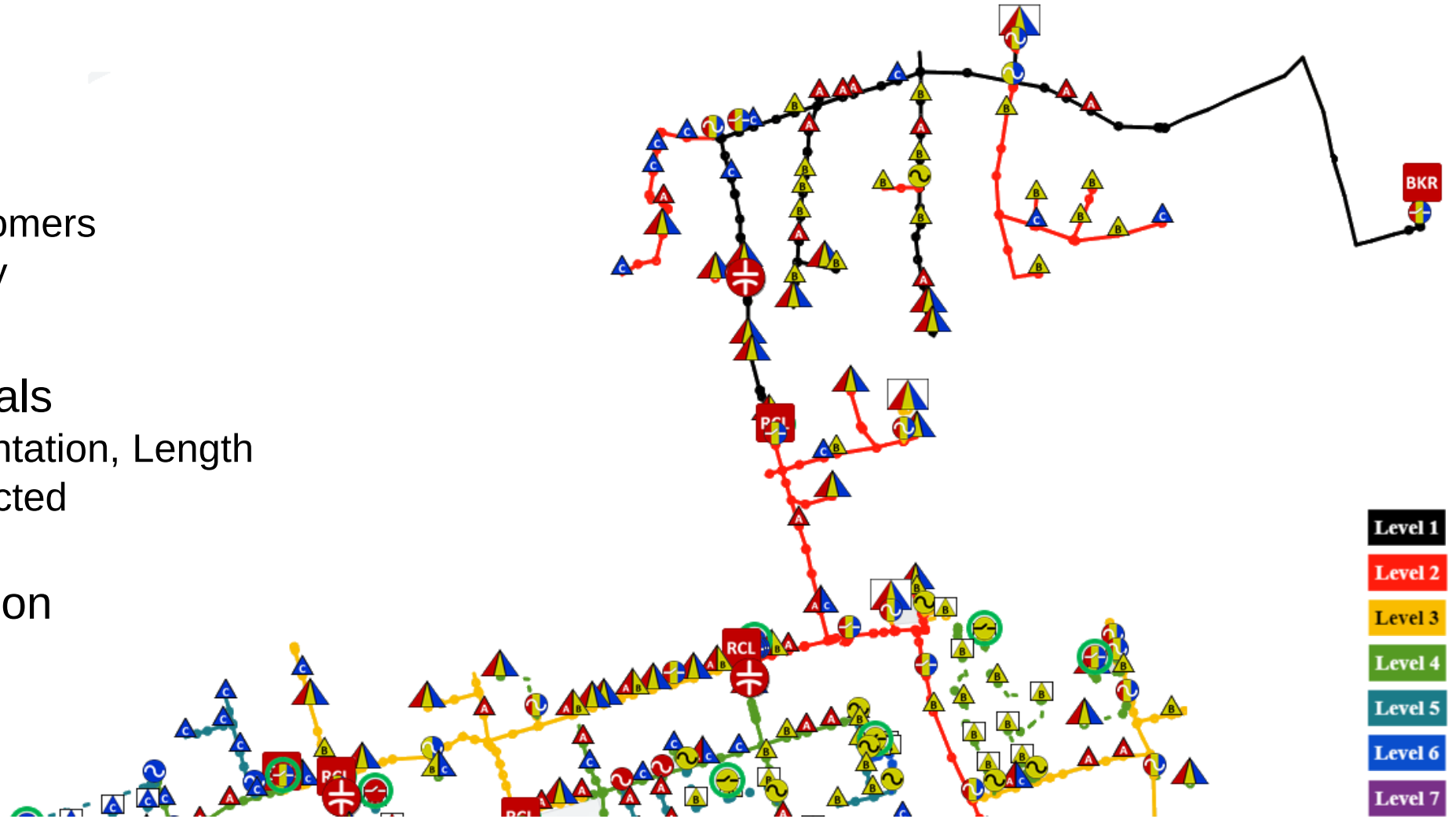
Can Spatial Intelligence play a role in data integration?

Can AI play a role in data cleansing or “True Up”?



*Advanced analytics integrate disparate data, **uses spatial intelligence**, and AI to make recommendations.*

- Network Topology
  - Risk Model
  - Impact Model
    - Connected Customers
    - Customer Priority
- Network Issues
  - Unprotected Laterals
    - Customers, Orientation, Length
    - Customers Impacted
  - Miscoordination
  - Circuit Segmentation
  - Phase Balancing
  - etc..



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  - Phase Balancing
  - etc..

Derive all the locations where each of these conditions exist.

Prioritize remedies based on risk, criticality, and impact.

*Advanced analytics **integrate disparate data, uses spatial intelligence**, and AI to make recommendations.*

- Proximity Analysis
  - Associate Disparate Data
    - Vegetation Work Locations
    - Asset Inspections & Photos
  - Rear-Lot equipment
  - Difficult Locations
  - LiDAR and Satellite
  - Regions & Areas
    - Weather, Flood & Fire zones
  - etc..

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  - etc.

Spatially relate data to all equipment, conductors, and facilities.

Factor this related data into risk analysis and prioritization for the various remedies.

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- Natural Language Processing and Machine Learning
- Focused on Unstructured Data
  - Notes, comments, free form fields
    - Outages
    - Customer Calls
    - Work Activities
    - Inspections
    - etc..
- Provide clues to Root Causes, Conditions, and Actions.

*Advanced analytics integrate disparate data, uses spatial intelligence, and **AI** to make recommendations.*

- Determine Damage vs Transient
  - Did a vegetation-caused event result in physical damage or something transient?
  - Did an animal-caused event result in physical damage or something transient?

- Determine other characteristics
  - Tree, Limb, Vines, Live Tree, Dead Tree
  - Pole, Crossarm, Insulator, etc..
  - Cable fault, splice, jacket, elbow
  - Arrestor, guard, etc..

- Train AI models from a large collection of utility data

*Advanced analytics integrate disparate data, uses spatial intelligence, and AI to **make recommendations**.*

CONFORM DATA

NETWORK, OUTAGES, INSPECTIONS, ETC.

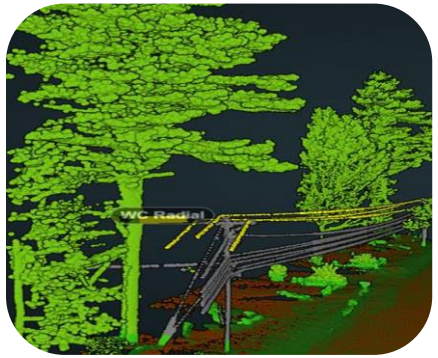
RISK OF FAILURE

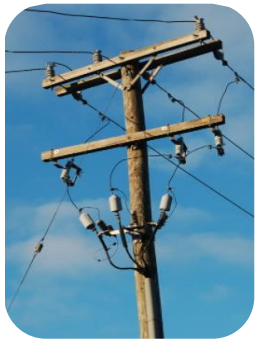
IMPACT OF FAILURE

ROOT CAUSE & EFFECT

AVAILABLE REMEDIES

- Lateral Fuse replacement
- Transform Fuse replacement
- Circuit Segmentation
- Tree Wire
- Cable Rejuvenation
- Undergrounding
- Upgrade Poles, Crossarms, Insulators
- Enhanced Vegetation Work
- Circuit Balancing
- Animal Guards
- Fire Mitigation
- Enhanced Inspections
- Recloser Replacement
- Etc.





Prioritizing Solutions that work by Ranking Impact and the Projected Results

CONFORM DATA

PROBLEMS, OUTAGES, INSPECTIONS, ETC.

RISK OF FAILURE

IMPACT OF FAILURE

ROOT CAUSE & EFFECT

AVAILABLE REMEDIES

RANKING

- Lateral Fuse replacement
- Transform Fuse replacement
- Circuit Segmentation
- Tree Wire
- Cable Rejuvenation
- Undergrounding
- Upgrade Poles, Crossarms, Insulators
- Enhanced Vegetation Work
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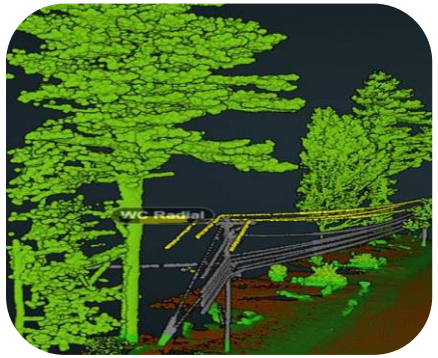
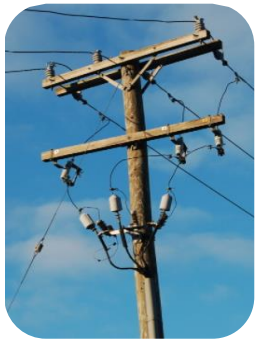
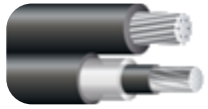






Prioritizing Solutions that work across work domains

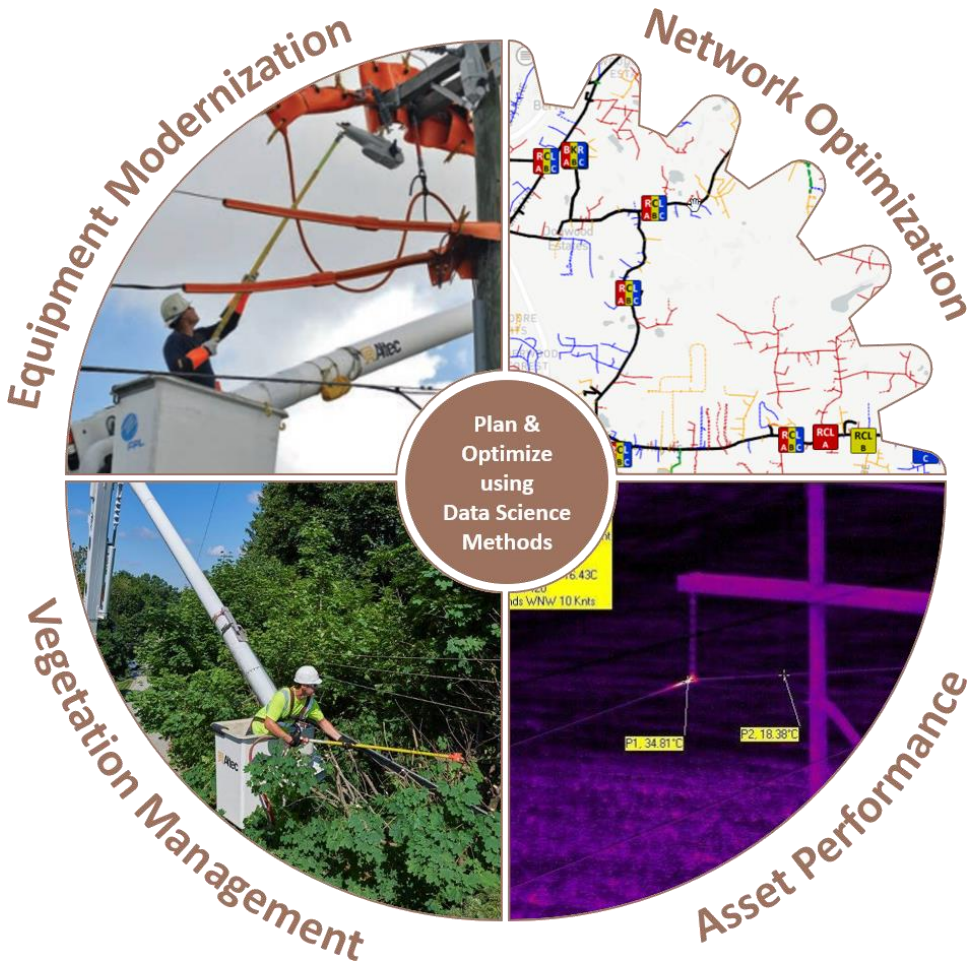
HISTORICAL PERFORMANCE

RISK RANKING

STRATEGIC PLAN & WORK TASKS

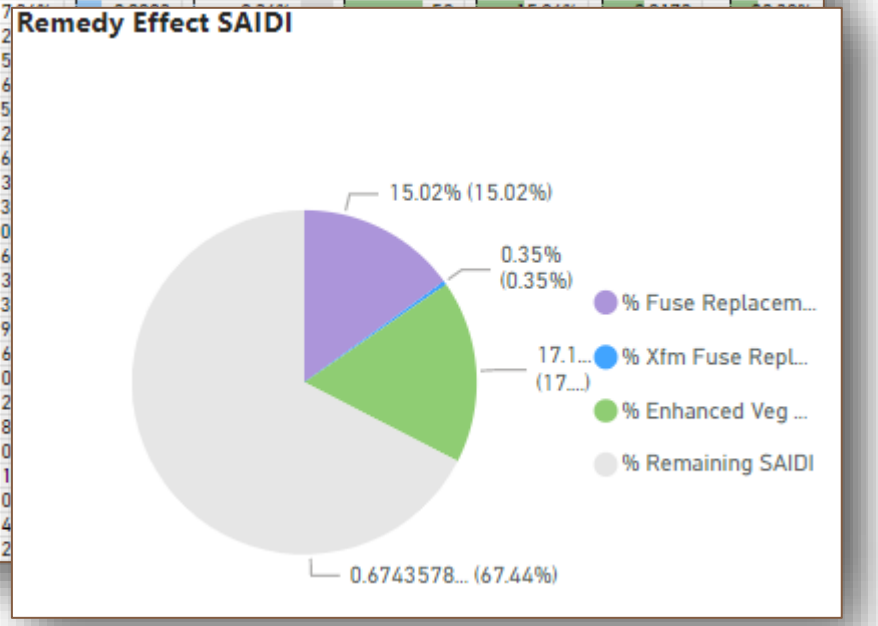
AVAILABLE REMEDIES

PROJECTED RESULTS



Prioritizing Solutions that work by Circuit Performance

Circuit	SAIDI Rank	Last Year SAIDI	Prior Year SAIDI	SAIFI Rank	Last Year SAIFI	Prior Year SAIFI	Last 2yr Events	Last 2yr SAIDI	Fuse Replace Outage Effect	Fuse Replace % Outage Effect	Fuse Replace SAIDI Effect	Fuse Replace % SAIDI Effect	Xfm Fuse Replace Outage Effect	Xfm Fuse Replace % Outage Effect	Xfm Fuse Replace SAIDI Effect	Xfm Fuse Replace % SAIDI Effect	Enhance Veg Outage Effect	% Enhanced Veg Events	Enhance Veg SAIDI Effect	% Enhanced Veg SAIDI
31-3	1	0.0917	0.1175	2	0.05	0.06	276	0.2092	39	14.13%	0.0152	7.25%	25.00	9.06%	0.0003	0.16%	34	12.32%	0.0352	16.81%
19-3	2	0.0788	0.0477	10	0.02	0.04	134	0.1264	8	5.97%	0.0006	0.50%	19.00	14.18%	0.0004	0.35%	19	14.18%	0.0170	13.46%
10-1	3	0.0741	0.0316	3	0.05	0.05	256	0.1057	83	32.42%	0.0238	22.51%	31.00	12.11%	0.0004	0.37%	33	12.89%	0.0091	8.63%
31-1	4	0.0265	0.0769	6	0.02	0.06	238	0.1033	21	8.82%	0.0099	9.62%	10.00	4.20%	0.0001	0.10%	42	17.65%	0.0290	28.04%
12-1	5	0.0418	0.0424	12	0.03	0.03	372	0.0843	122	32.80%	0.0197	23.39%	27.00	7						
17-3	6	0.0260	0.0568	19	0.01	0.03	258	0.0828	49	18.99%	0.0116	14.04%	7.00	2						
39-2	7	0.0392	0.0375	4	0.05	0.05	224	0.0767	27	12.05%	0.0133	17.31%	12.00	5						
24-3	8	0.0354	0.0351	5	0.05	0.04	188	0.0705	35	18.62%	0.0120	17.05%	13.00	6						
50-6	9	0.0236	0.0465	9	0.03	0.05	54	0.0701	18	33.33%	0.0133	19.01%	3.00	5						
27-1	10	0.0552	0.0113	1	0.10	0.06	182	0.0665	22	12.09%	0.0034	5.18%	23.00	12						
49-6	11	0.0138	0.0500	7	0.03	0.05	92	0.0639	21	22.83%	0.0102	15.94%	6.00	6						
32-3	12	0.0493	0.0138	13	0.04	0.02	32	0.0631	0	0.00%	0.0000	0.00%	1.00	3						
15-1	13	0.0082	0.0493	28	0.00	0.03	28	0.0576	0	0.00%	0.0000	0.00%	1.00	3						
25-1	14	0.0435	0.0139	16	0.02	0.03	180	0.0574	31	17.22%	0.0093	16.26%	19.00	10						
18-2	15	0.0203	0.0357	20	0.01	0.03	122	0.0560	19	15.57%	0.0194	34.70%	8.00	6						
20-1	16	0.0468	0.0080	14	0.04	0.01	130	0.0547	21	16.15%	0.0016	2.97%	17.00	13						
17-2	17	0.0186	0.0339	8	0.02	0.06	338	0.0525	84	24.85%	0.0062	11.90%	13.00	3						
33-1	18	0.0423	0.0092	18	0.04	0.00	42	0.0515	0	0.00%	0.0000	0.00%	4.00	9						
21-4	19	0.0286	0.0224	15	0.01	0.04	142	0.0510	32	22.54%	0.0088	17.21%	9.00	6						
34-1	20	0.0284	0.0221	21	0.02	0.02	102	0.0505	20	19.61%	0.0124	24.57%	11.00	10						
25-5	21	0.0424	0.0061	25	0.03	0.00	152	0.0485	32	21.05%	0.0047	9.76%	4.00	2						
35-4	22	0.0367	0.0116	11	0.03	0.03	172	0.0484	34	19.77%	0.0117	24.29%	14.00	8						
15-3	23	0.0021	0.0393	46	0.00	0.02	16	0.0415	0	0.00%	0.0000	0.00%	0.00	0						
35-1	24	0.0320	0.0066	30	0.02	0.01	78	0.0386	11	14.10%	0.0018	4.68%	1.00	1						
16-8	25	0.0282	0.0071	32	0.02	0.00	82	0.0354	1	1.22%	0.0000	0.12%	0.00	0						
23-4	26	0.0218	0.0133	26	0.02	0.01	206	0.0350	53	25.73%	0.0128	36.45%	9.00	4						
25-3	27	0.0288	0.0056	29	0.02	0.00	108	0.0344	4	3.70%	0.0002	0.47%	3.00	2						



Prioritizing Solutions that work by Circuit Performance and Cost

Circuit	SAIDI Rank	Last Year SAIDI	Prior Year SAIDI	SAIFI Rank	Last Year SAIFI	Prior Year SAIFI	Last 2yr Events	Last 2yr SAIDI	Fuse Replace Outage Effect	Fuse Replace % Outage Effect	Fuse Replace SAIDI Effect	Fuse Replace % SAIDI Effect	Xfm Fuse Replace Outage Effect	Xfm Fuse Replace % Outage Effect	Xfm Fuse Replace SAIDI Effect	Xfm Fuse Replace % SAIDI Effect	Enhance Veg Outage Effect	% Enhanced Veg Events	Enhance Veg SAIDI Effect	% Enhanced Veg SAIDI
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50-6	9	0.0236	0.0465	9	0.03	0.05	54	0.0701	18	33.33%	0.0133	19.01%	3.00							
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32-3	12	0.0493	0.0138	13	0.04	0.02	32	0.0631	0	0.00%	0.0000	0.00%	1.00							
15-1	13	0.0082	0.0493	28	0.00	0.03	28	0.0576	0	0.00%	0.0000	0.00%	1.00							
25-1	14	0.0435	0.0139	16	0.02	0.03	180	0.0574	31	17.22%	0.0093	16.26%	19.00							
18-2	15	0.0203	0.0357	20	0.01	0.03	122	0.0560	19	15.57%	0.0194	34.70%	8.00							
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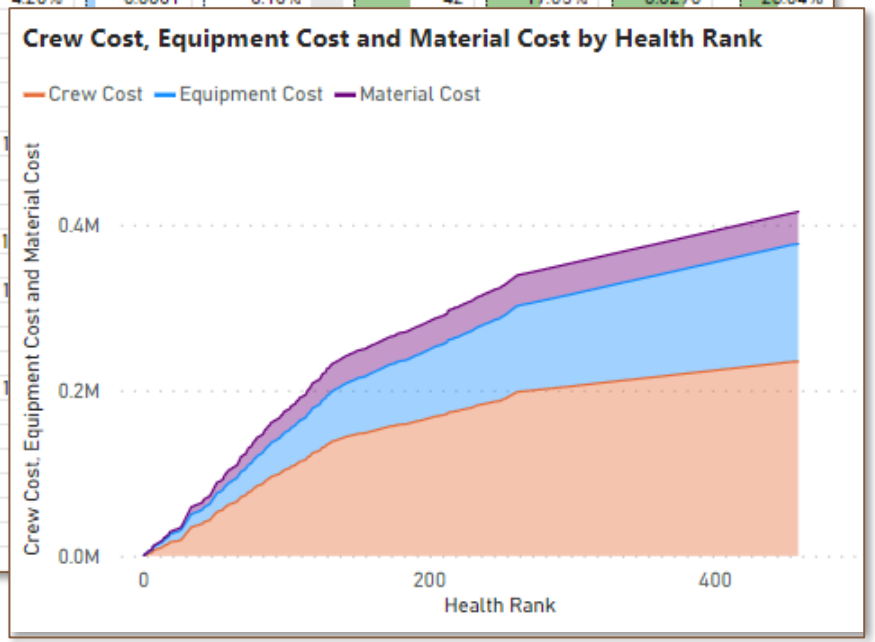
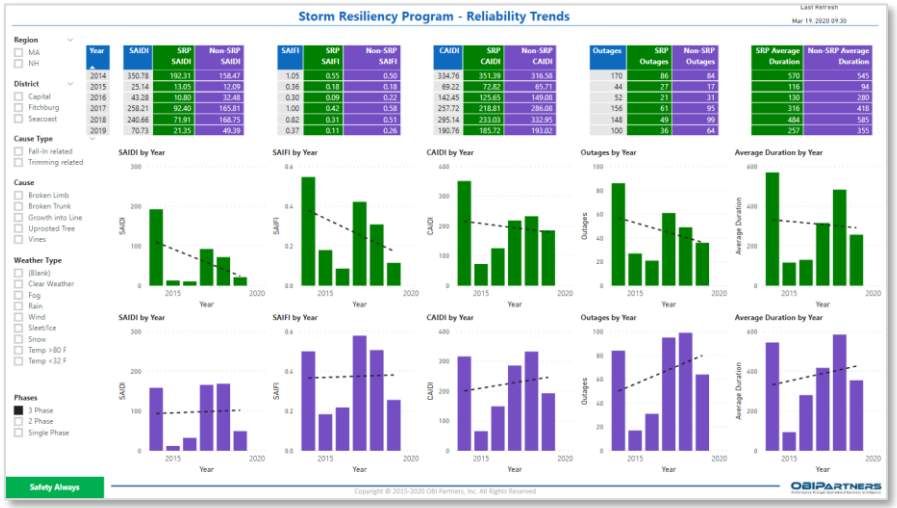


Measuring Benefits Achieved – The Targets

- Did the solution reduce
  - total outages experienced
  - frequency of outages
  - storm related outages
  - outage duration
- Did the solutions produce cost savings
  - Were there cost savings for the Utility
  - Were there cost savings for the Customers
    - Avoided Customer Revenue loss due to outages.



Measuring Benefits Achieved – The Results

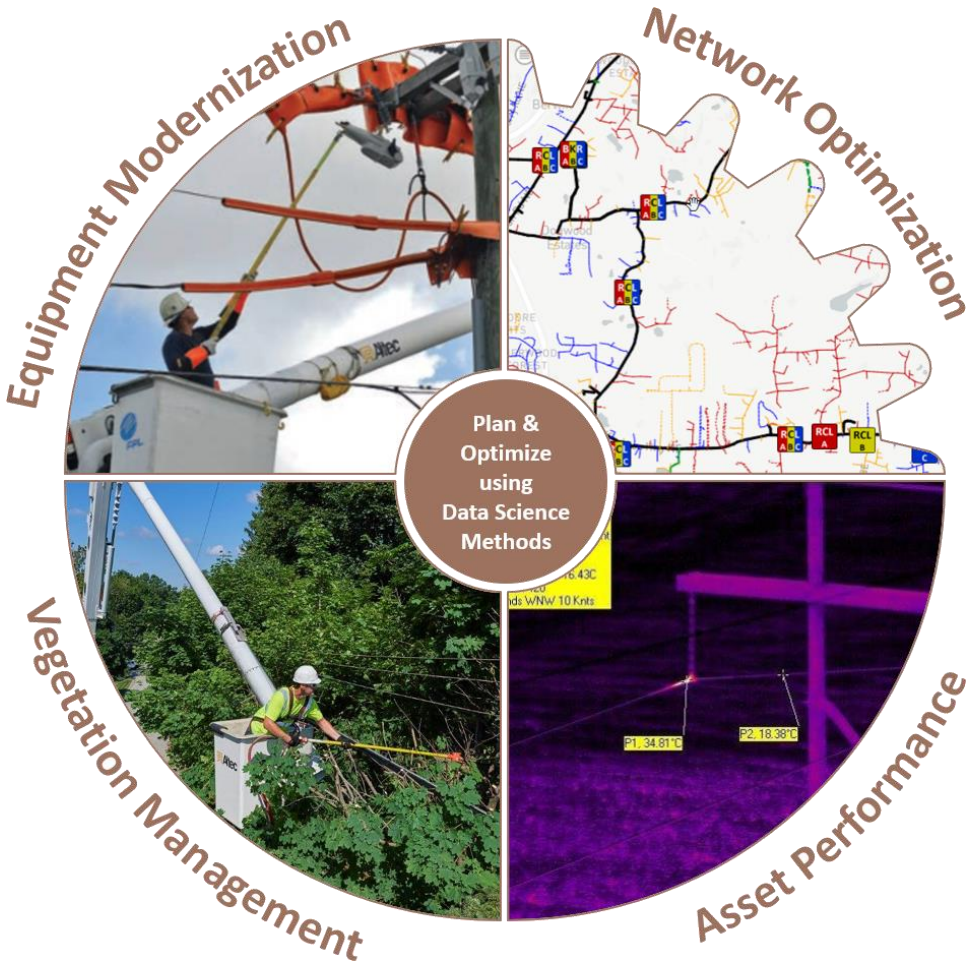
Year	SAIDI	SRP SAIDI	Non-SRP SAIDI	SAIFI	SRP SAIFI	Non-SRP SAIFI	CAIDI	SRP CAIDI	Non-SRP CAIDI	Outages	SRP Outages	Non-SRP Outages	SRP Average Duration	Non-SRP Average Duration
2014	350.78	192.31	158.47	1.05	0.55	0.50	334.76	351.39	316.58	170	86	84	570	545
2015	25.14	13.05	12.09	0.36	0.18	0.18	69.22	72.82	65.71	44	27	17	116	94
2016	43.28	10.80	32.48	0.30	0.09	0.22	142.45	125.65	149.08	52	21	31	130	280
2017	258.21	92.40	165.81	1.00	0.42	0.58	257.72	218.81	286.08	156	61	95	316	418
2018	240.66	71.91	168.75	0.82	0.31	0.51	295.14	233.03	332.95	148	49	99	484	585
2019	70.73	21.35	49.39	0.37	0.11	0.26	190.76	185.72	193.02	100	36	64	257	355

Measuring Benefits Achieved – The Results – Storm Focus

Year	SAIDI	SRP SAIDI	Non-SRP SAIDI	SAIFI	SRP SAIFI	Non-SRP SAIFI	CAIDI	SRP CAIDI	Non-SRP CAIDI	Outages	SRP Outages	Non-SRP Outages	SRP Average Duration	Non-SRP Average Duration
2014	116.20	81.49	34.71	0.58	0.33	0.26	199.51	249.28	135.85	77	42	35	307	249
2015	13.23	4.82	8.41	0.18	0.06	0.11	75.31	76.56	74.62	18	11	7	131	128
2016	37.26	6.53	30.74	0.22	0.03	0.19	170.24	214.28	163.12	37	11	26	149	319
2017	192.24	54.85	137.39	0.68	0.29	0.39	281.05	186.94	351.75	98	39	59	267	431
2018	72.73	23.07	49.66	0.35	0.11	0.25	205.68	212.81	202.52	70	23	47	305	323
2019	41.01	16.38	24.63	0.26	0.09	0.17	155.78	185.40	140.83	64	21	43	269	334

By leveraging disparate data, spatial intelligence, and AI we can solve this problem.

- ***IDENTIFY ROOT CAUSES AFFECTING GRID RELIABILITY***
  - ***IDENTIFY COST-EFFECTIVE REMEDIES***
    - ***OPTIMIZE WORK & SPEND FOR IMPACT & PRIORITY***



Take Away

We discussed how we can use this data and analysis to derive strategic plans across multiple grid resiliency programs.

Grid resiliency improvements, driven by reliability, safety, increasing customer demand, changing load and generation mix, and changing financial pressures and opportunities, are best managed with a dynamic solution that provides ongoing analysis, adapting to those changes, measuring the actual results, and using those results to further refine your strategic and tactical plans.

For more information or follow up please contact

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