How Industry Can Benefit from Big Data?

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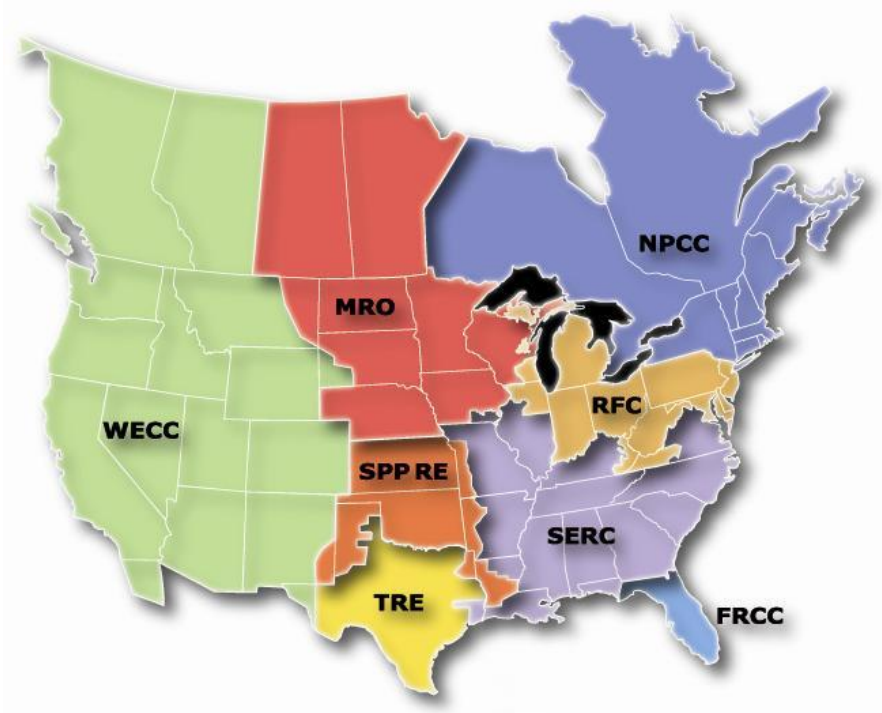
North American Electric Reliability Corp. (NERC)

What is NERC?

- NERC was certified as ERO by the U.S. Federal Energy Regulatory Commission (FERC) in 2006
- Partnership with eight (8) regional entities to manage reliability in North America
- FERC provides oversight, approves standards and ERO budgets (NERC/regions)

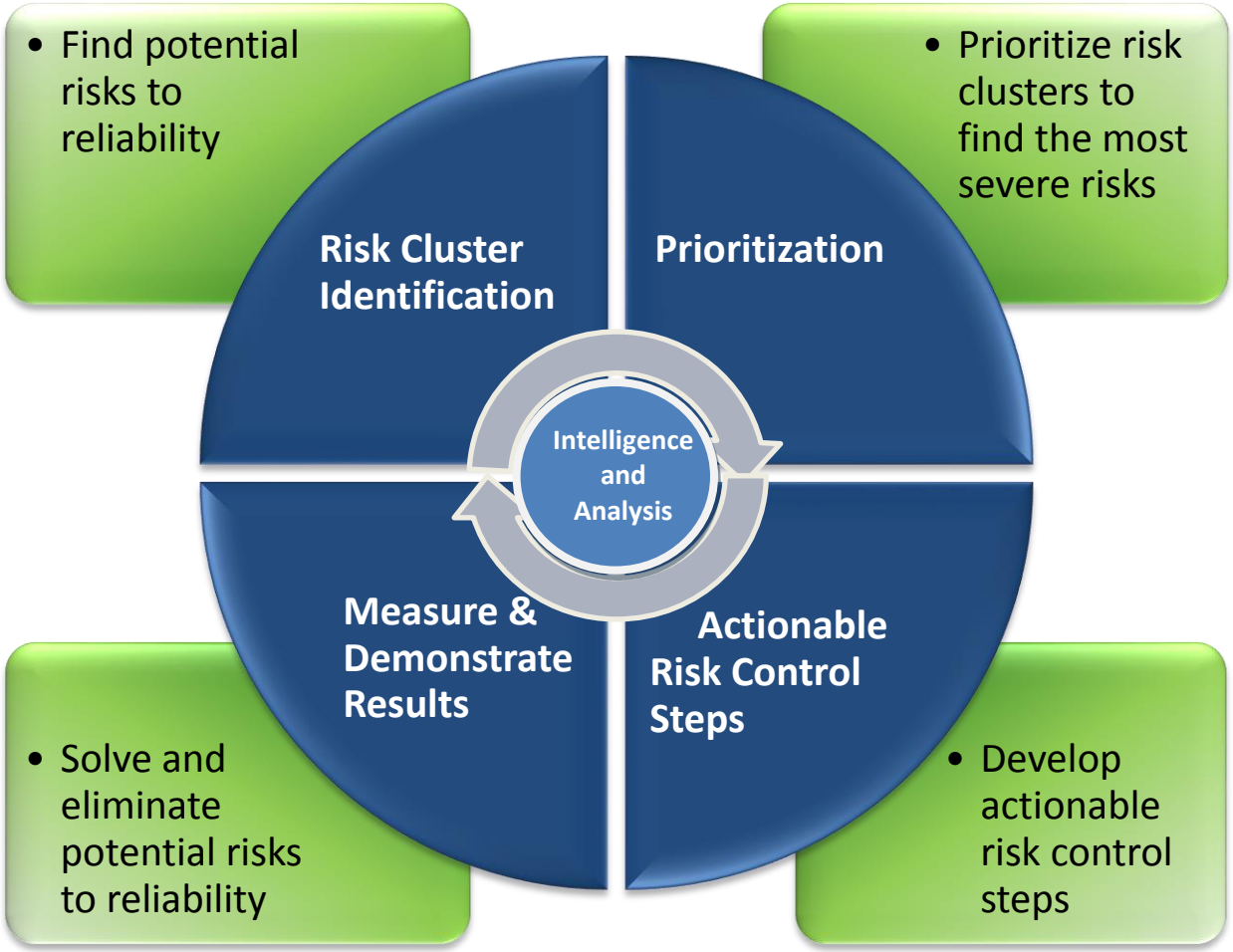


About NERC: Mission

To ensure the reliability of the North American bulk power system

- Develop and enforce reliability standards
- Assess current and future reliability
- Analyze system events and recommend improved practices
- Accountable as ERO to regulators in the United States (FERC) and Canada (NEB and provincial governments)

Risk Issues and Reduction



Data-Driven Assessment

2010

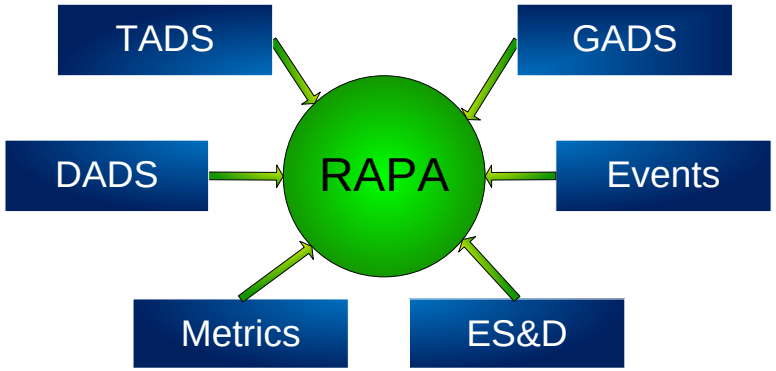
- Develop reliability measures
- Publish performance trending on NERC website
- Refine and implement risk assessment tools

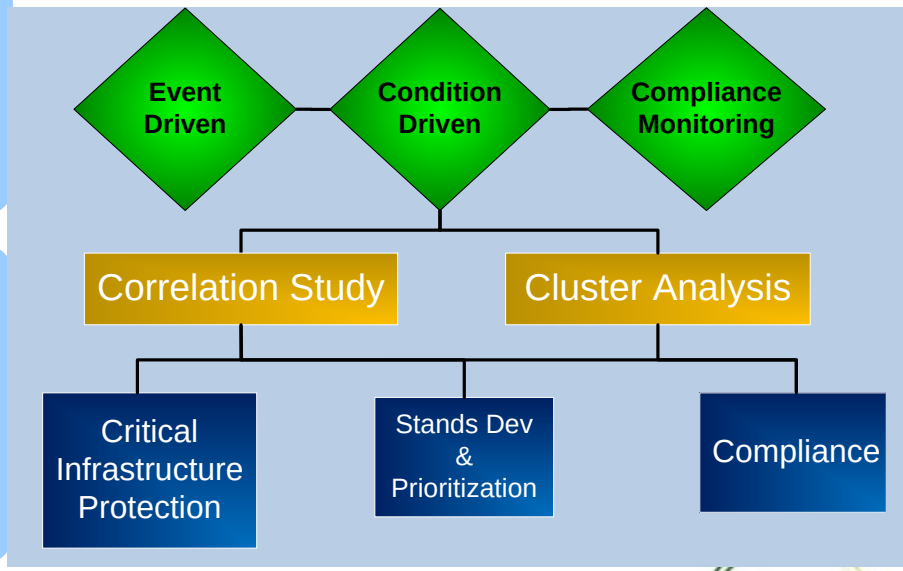
2011

- 18 reliability indicators
- First annual report
- Identify areas of highest risk to reliability
- Recommend standard changes

2012

- Issue annual state of reliability report
- Event-Driven Index (EDI)
- Key Compliance Monitoring Index (KCMI)
- Condition-Driven Index (CDI)





Equipment Performance - ADS

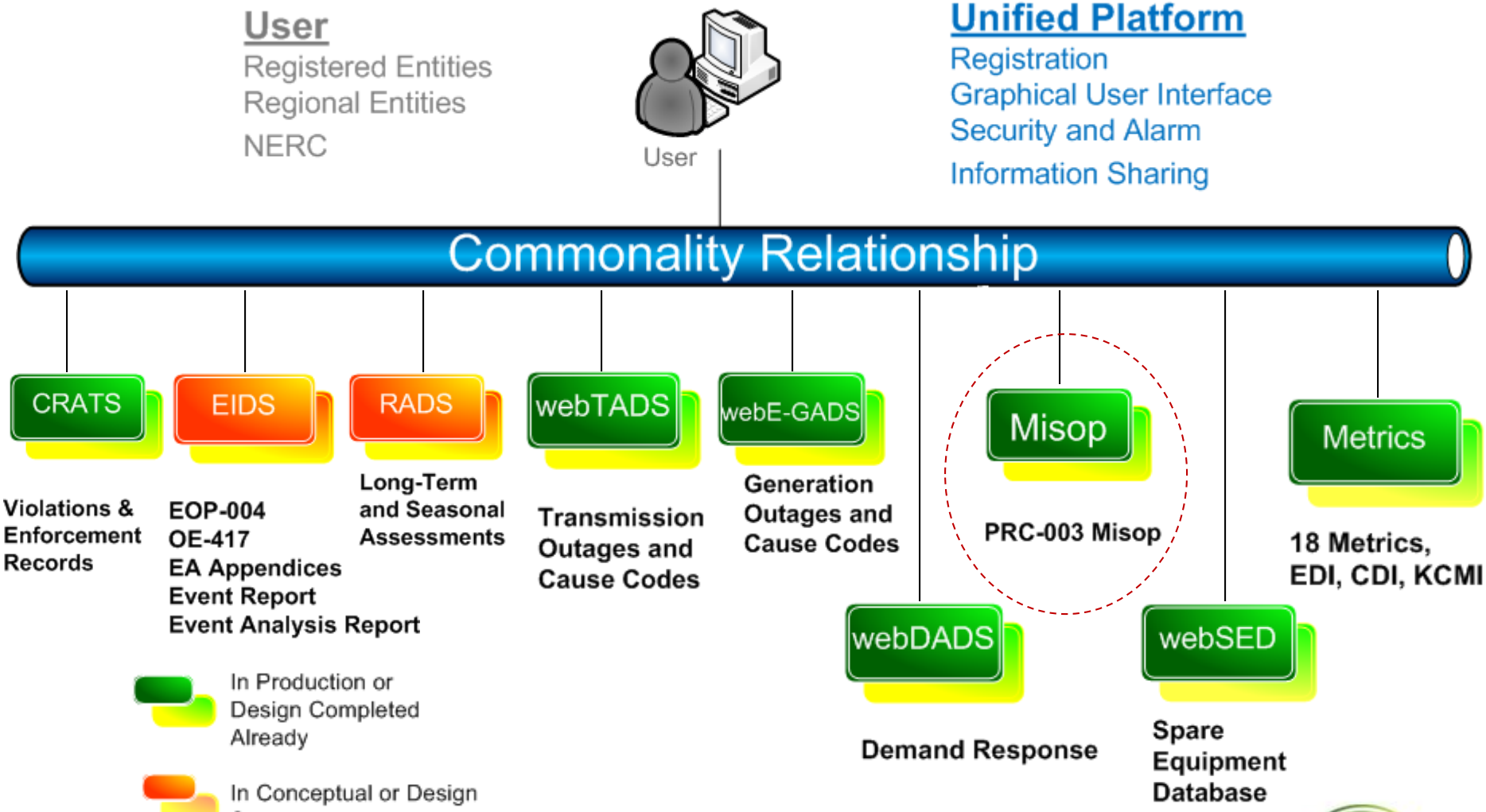
ADS = Availability Data Systems

NERC has:

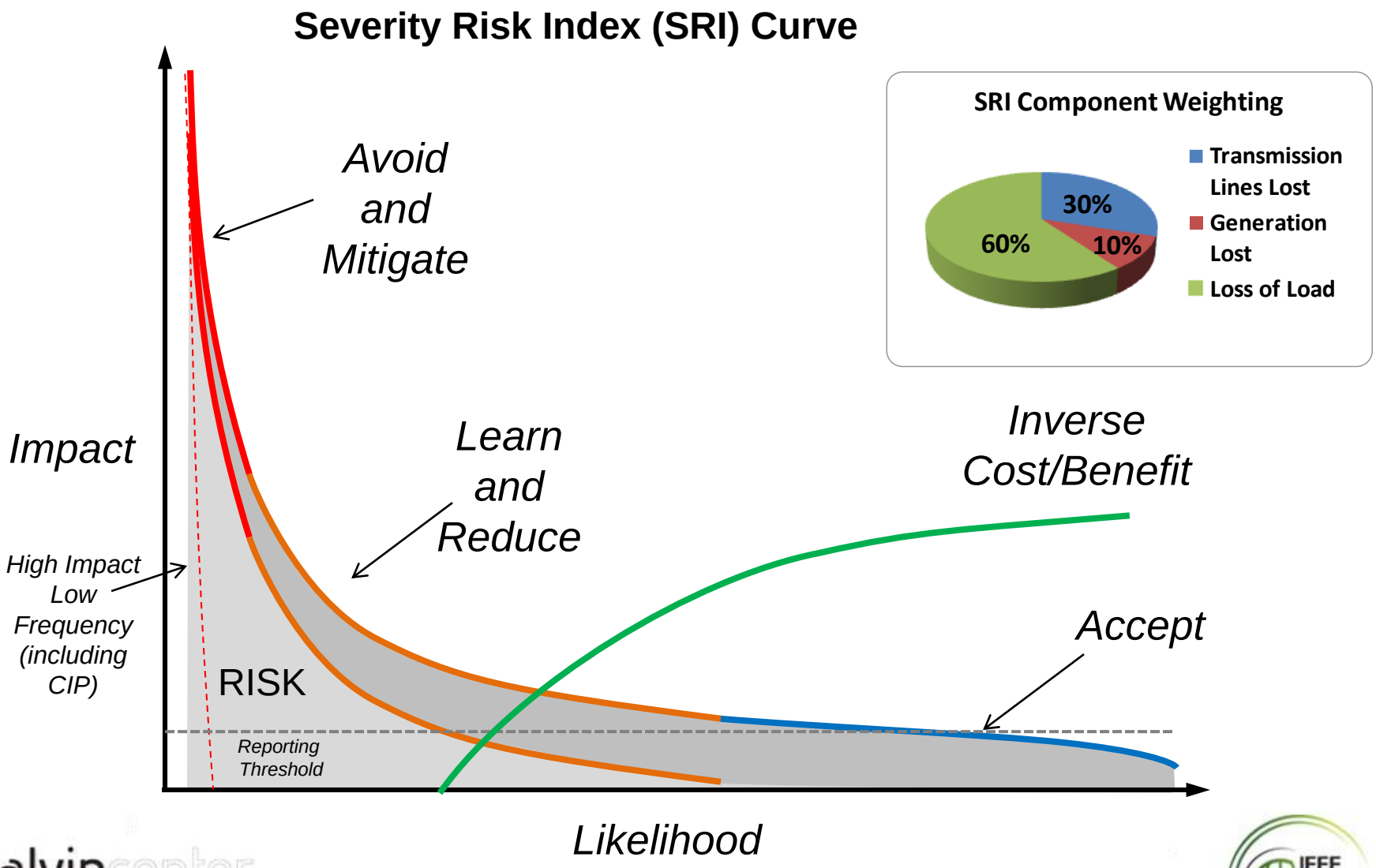
- GADS (1972) – mandatory reporting (2012)
- TADS (2008) – mandatory reporting
- DADS (2011) – mandatory reporting
- SED (2012) – voluntary reporting

Provides data that feeds into benchmarking, reliability analysis, and system risk index

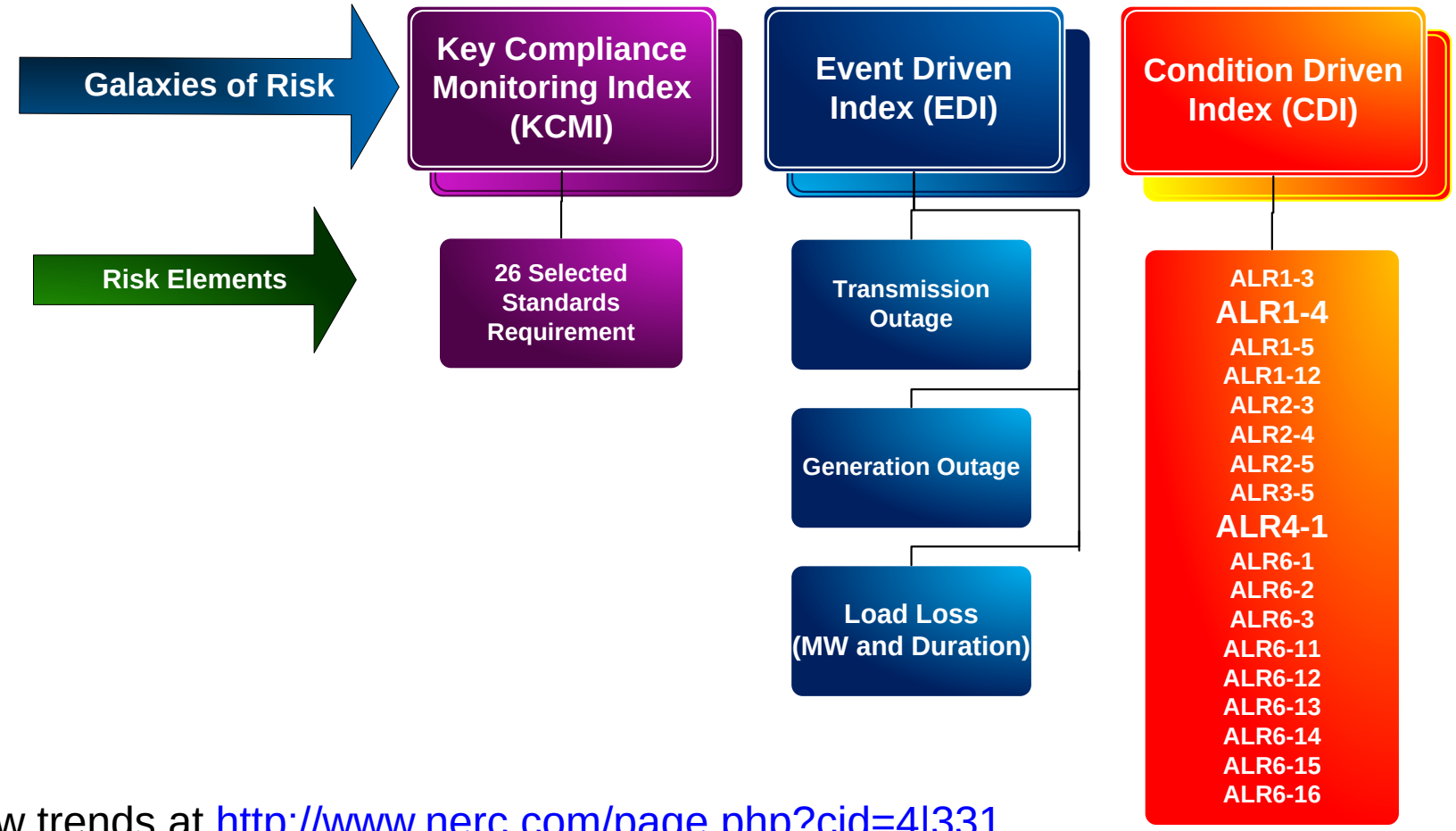
Supporting Data



Measure Risk from Events



Tiered Approach



View trends at http://www.nerc.com/page.php?cid=4|331

Reliability Metrics

ALR 1-3	Reserve Margin
ALR 1-4	BPS Transmission Related Events Resulting in Loss of Load
ALR 2-4	Disturbance Control Standard Failures (DCS Failures)
ALR 2-5	Disturbance Control Events Greater than Most Severe Single Contingency (MSSC)
ALR 3-5	IROL/SOL Exceedance
ALR 4-1	Protection System Misoperations
ALR 6-1	Transmission Constraint Mitigation
ALR 6-2	Energy Emergency Alert 3 (EEA 3)
ALR 6-3	Energy Emergency Alert 2 (EEA 2)

Reliability Metrics (cont'd)

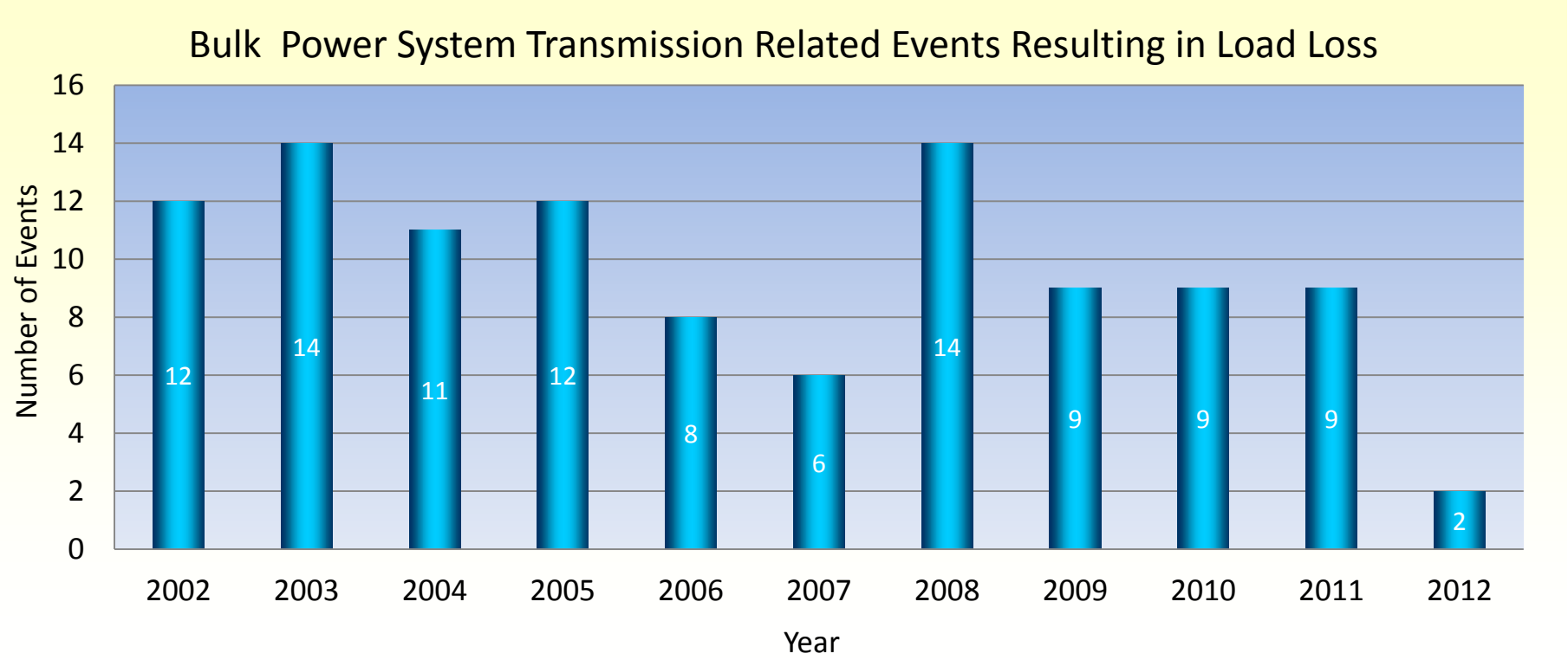
ALR1-5	System Voltage Performance
ALR1-12	Interconnection Frequency Response
ALR2-3	UFLS and UVLS Usage
ALR6-11	Automatic AC Transmission Outages Initiated by Failed Protection System Equipment
ALR6-12	Automatic AC Transmission Outages Initiated by Human Error
ALR6-13	Automatic AC Transmission Outages Initiated by Failed AC Substation Equipment
ALR6-14	Automatic AC Circuit Outages Initiated by Failed AC Circuit Equipment
ALR 6-15	Element Availability Percentage
ALR 6-16	Transmission System Unavailability due to Automatic Outages

Annual State of Reliability Report

- Purpose – Objectively provide an integrated view of reliability performance
- Serve as risk-informed input to:
  - Standards and project prioritization
  - Compliance process improvement
  - Event analysis, reliability assessment, and CIP
- Reference for trends risks to reliability
- Offer analytical insights towards actionable risk control

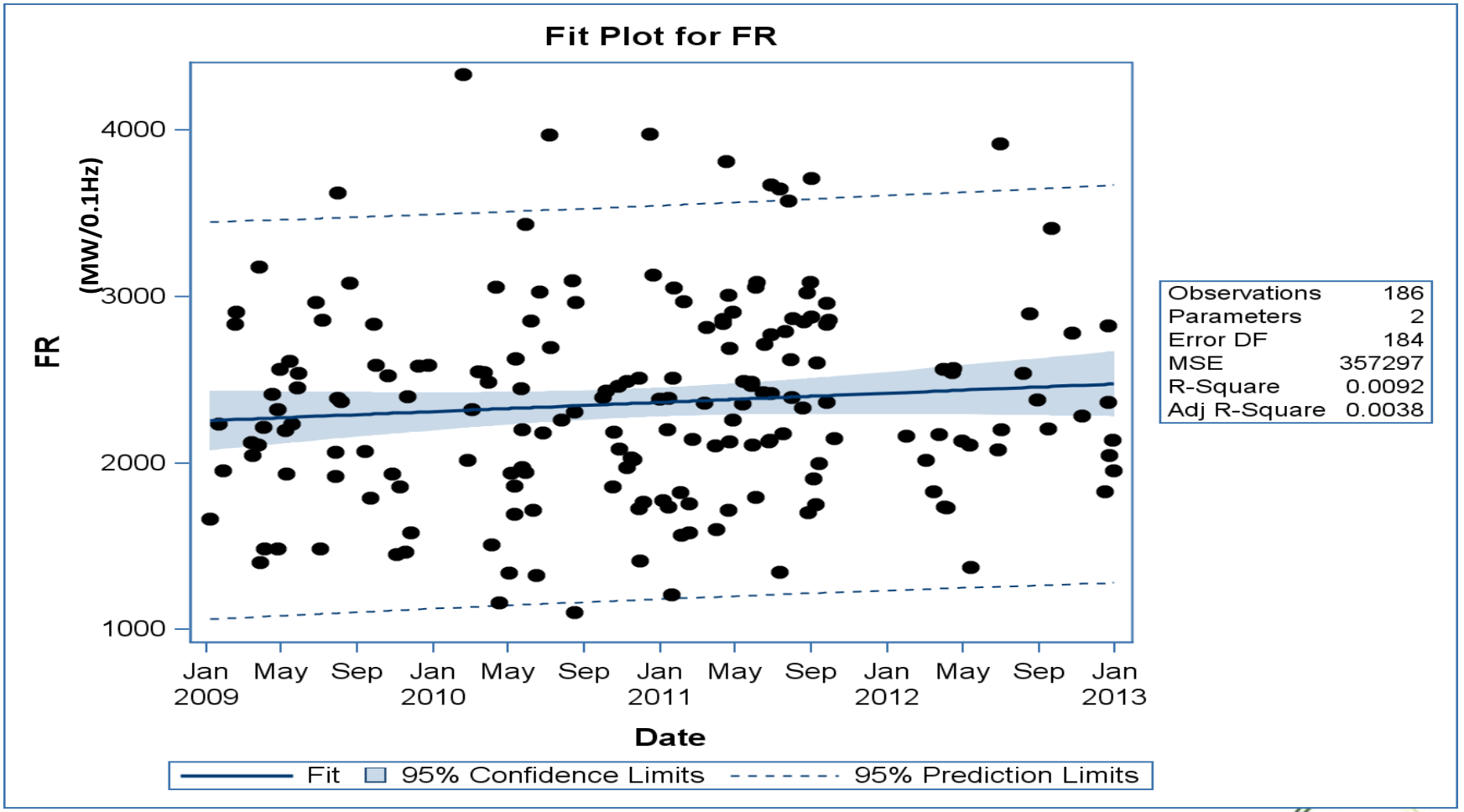
2013 BPS Reliability Remains Adequate

- Bulk power system reliability stable within ALR conditions
  - For 2008 to 2012, no significant upward or downward trends
  - Consistent 97% AC circuit availability



Frequency Response (FR) Stable

- Further analysis for EI FR events with less than 1,500 MW/0.1Hz

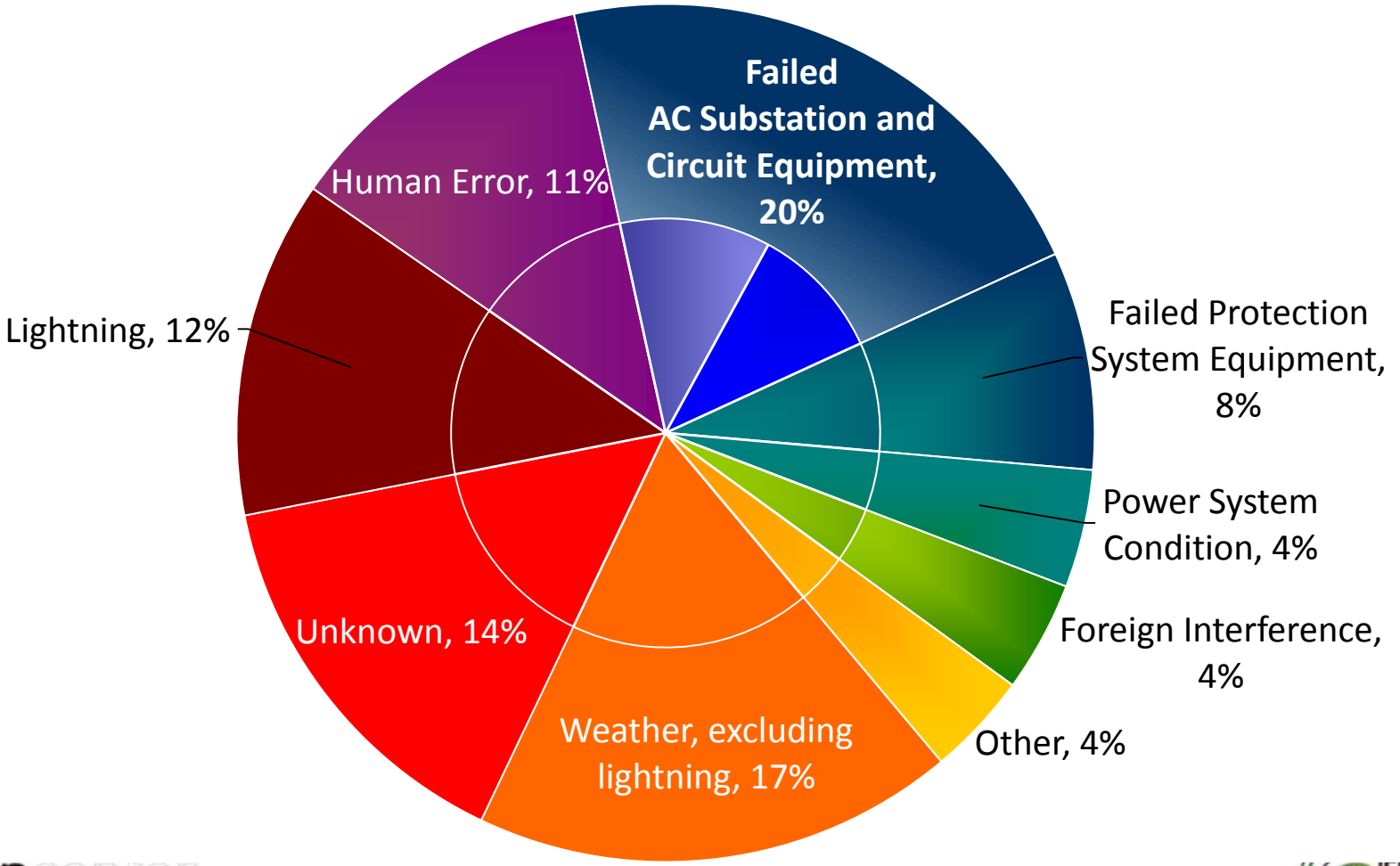


Misoperations Significant Risk Issue

- Protection System Misoperations are a Significant Contributor to Disturbance Events and Automatic Transmission Outage Severity
  - Largest positive correlation with 2012 automatic transmission outage severity
- Industry Actionable Steps Recommended
  - 65% from three leading causes
  - Summarized in Protection System Misoperations Task Force (PSMTF) report
- Performance Measure Implemented

Equipment Failure Warrants Analysis

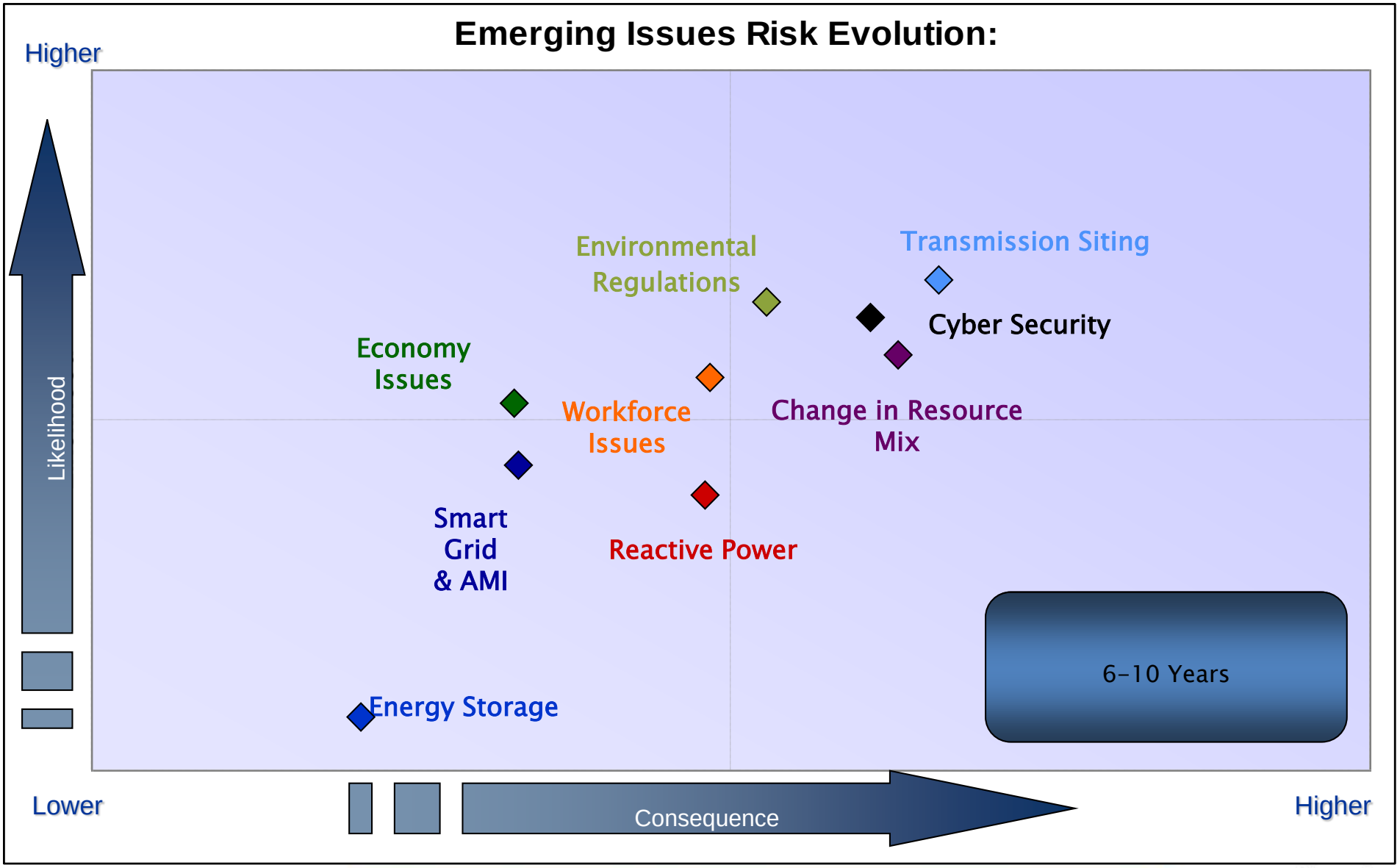
AC Circuit Sustained Automatic Outages by Initiating Cause Code



NERC Reliability Assessments

- Peak Demand Forecasts
- Resource Adequacy
- Transmission Adequacy
- Key Issues & Emerging Trends
- Regional Self-Assessment
- Ad-hoc Special Assessments

Risk Assessment for Emerging & Standing Issues

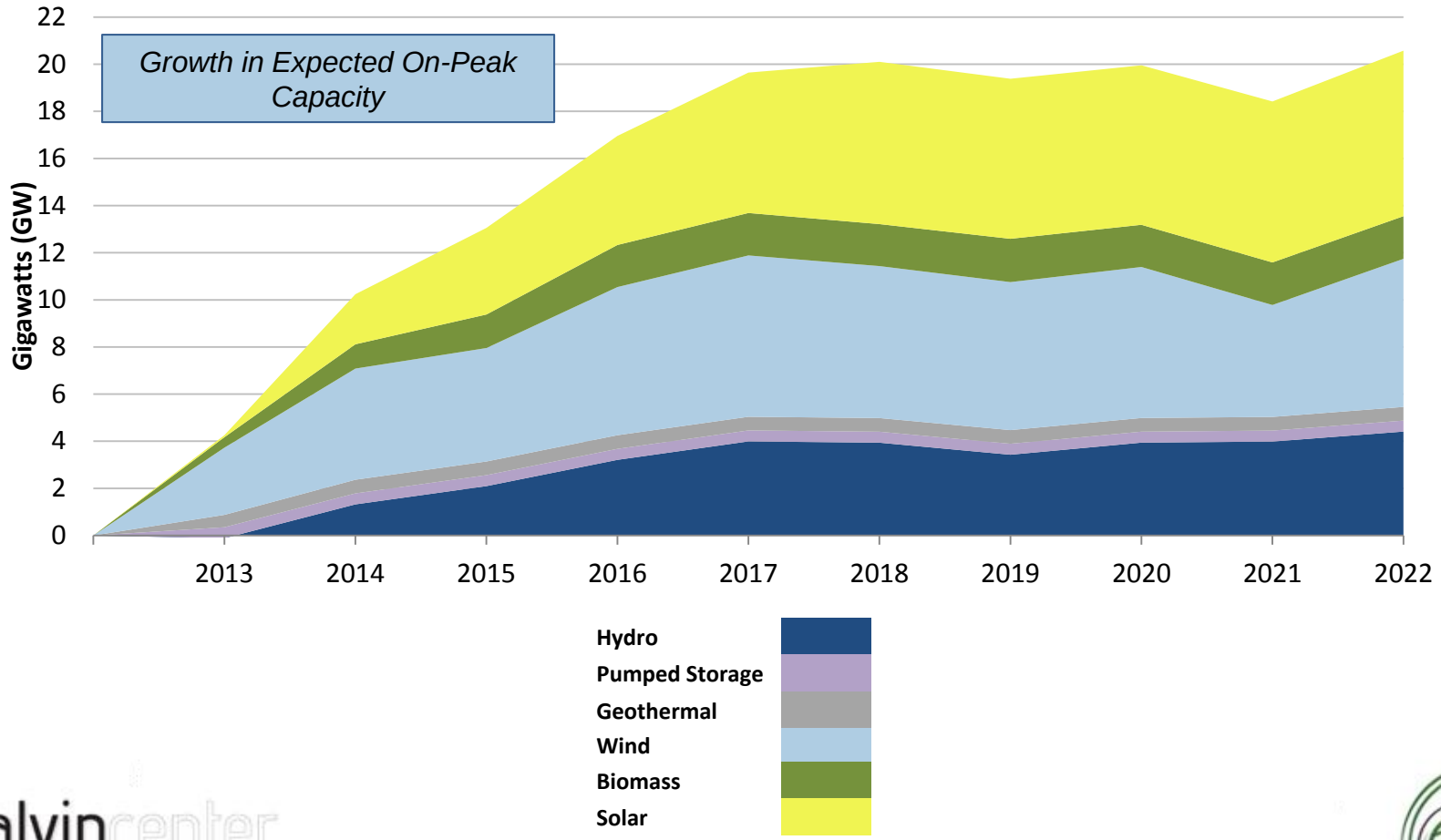


Recent Achievements

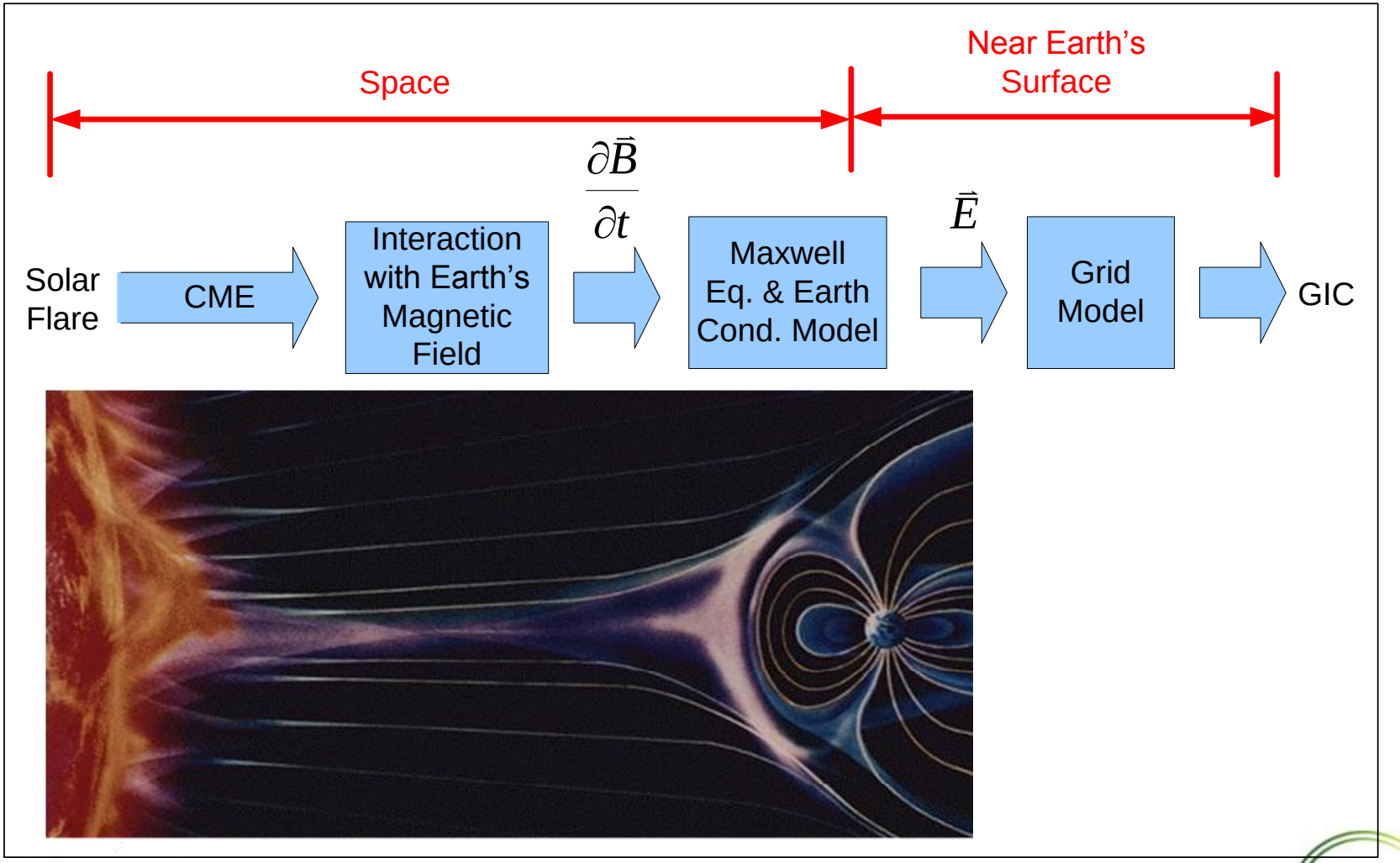
- Reliability Considerations for Smart Grid
- Increasing Dependence on Natural Gas for Electric Power
- Reliability Issues of Climate Change Initiatives
- Impacts of Fossil-Fired Generation Retirements (Environmental Regulations)
- Effects of Geomagnetic Disturbances
- Integration of Variable Generation
- Integrate Probabilistic Assessment into Long-Term Reliability Assessment
- Impacts of Swift Economic Recovery

Key Finding: Change in Resource Mix

Renewables and Gas-Fired Capacity Represent Largest Growth of Installed Capacity Introducing New System Planning and Operational Challenges



Geomagnetic Disturbances



Reliability Model

2013

- Event Information Data Store
- Risk clusters using integrated and comprehensive datasets
- Quarterly TADS reporting
- Transmission inventory data

2014

- Common view of causes – Events, TADS, GADS, Misops and related systems
- Technical analysis for performance/risk/results-based standards

2015

- Cause-Effect Reliability Model
- Predict future performance
- Statistically link reliability reduction cause & effect
- Recommend standard changes and prioritization

Work Plan

- **9 Top Initiating Events**
- **Cover 60-70% of risk factors**
- **BRIIE Index - Baseline Risk Index for Initiating Events (Nuc Industry)**

Future

- **Probabilistic cause/effect model**
- **Quantify and predict reliability**

Risk = Probability*Impact

Questions and Answers