



## Resilient Power Architectures for Critical Power



# Complete Solutions Provider

The powerhouse in hydrogen fuel cell technology for material handling and stationary customers.

- Headquarters in Latham, New York
  - Founded in June 1997
  - Over 300 total employees
  - Offices in Spokane, Washington
- World class manufacturing facilities in NY and WA
- Over 9,500 units in the field
  - >100 million hours of runtime by material handling customers
  - >100 million hours of backup coverage for stationary customers
- Focused R&D activities
  - 189 issued patents
  - Polymer & catalyst technology
  - Hydrogen storage & generation



**GenKey**  
Power • Fuel • Serve

**GenDrive** **ReliOn**  
**GenFuel** **GenCare**

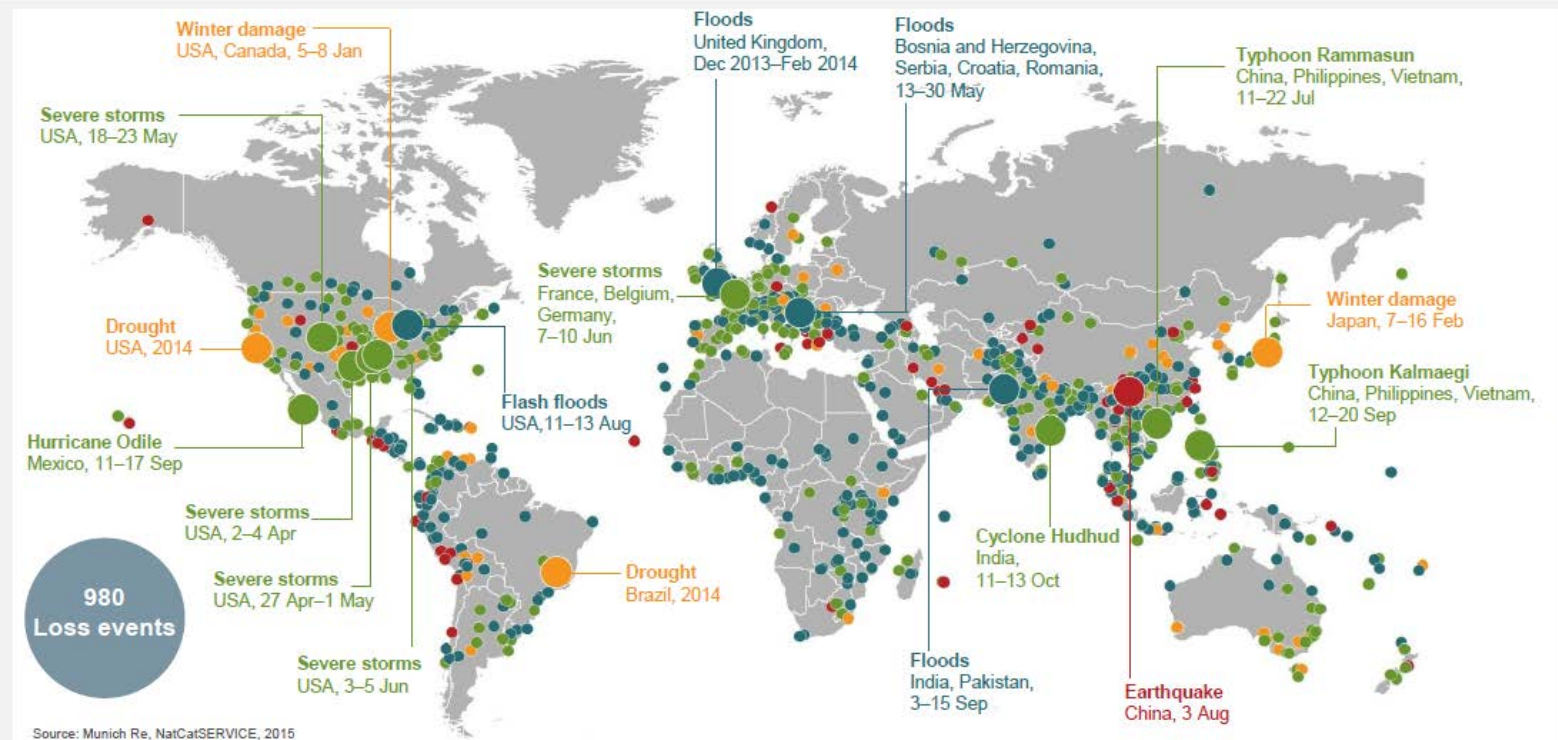
- ▶ The Need For Power
- ▶ Reliability and Resiliency
- ▶ Hydrogen and Fuel Cells
- ▶ Fuel Cell Power in a Network
- ▶ Case Study: SouthernLinc
- ▶ Case Study: WSP
- ▶ Commercial Resources
- ▶ Stationary Power China
- ▶ Summary

NatCatSERVICE

## Loss events worldwide 2014

### Geographical overview

Munich RE



○ Loss events

○ Selection of catastrophes  
Overall losses ≥ US\$ 1,500m

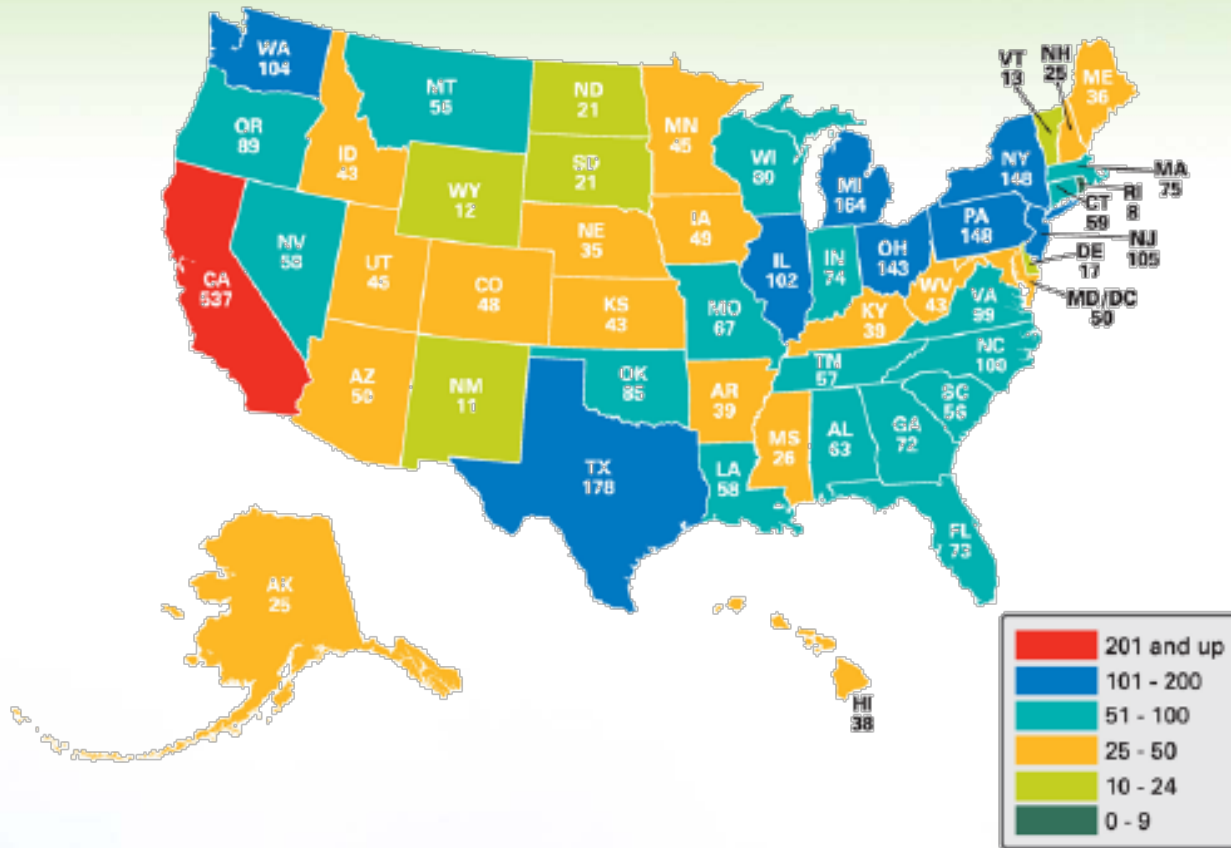
● Geophysical events  
(Earthquake, tsunami, volcanic activity)

● Meteorological events  
(Tropical storm, extratropical storm, convective storm, local storm)

● Hydrological events  
(Flood, mass movement)

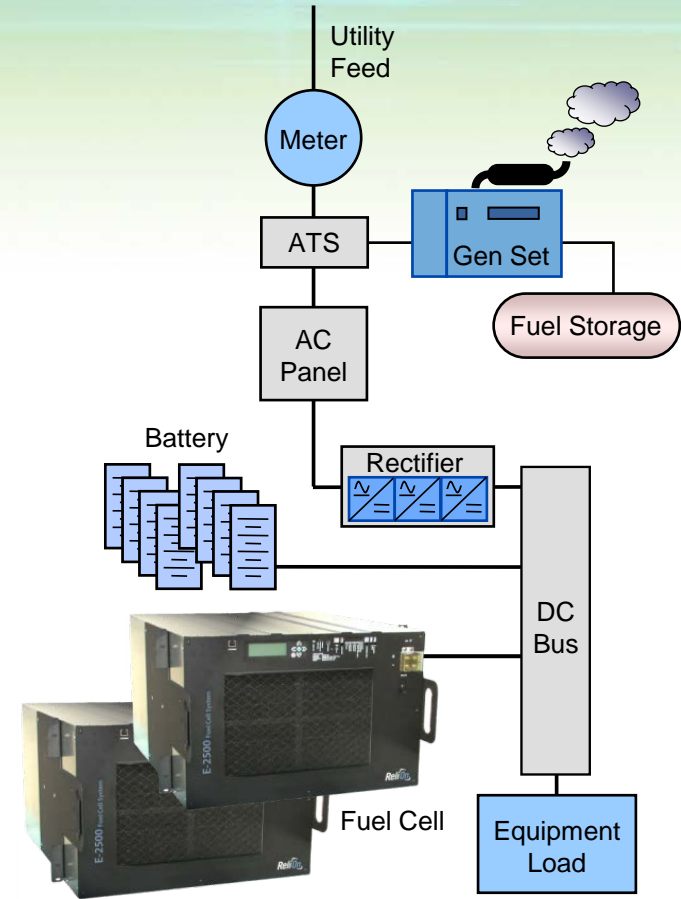
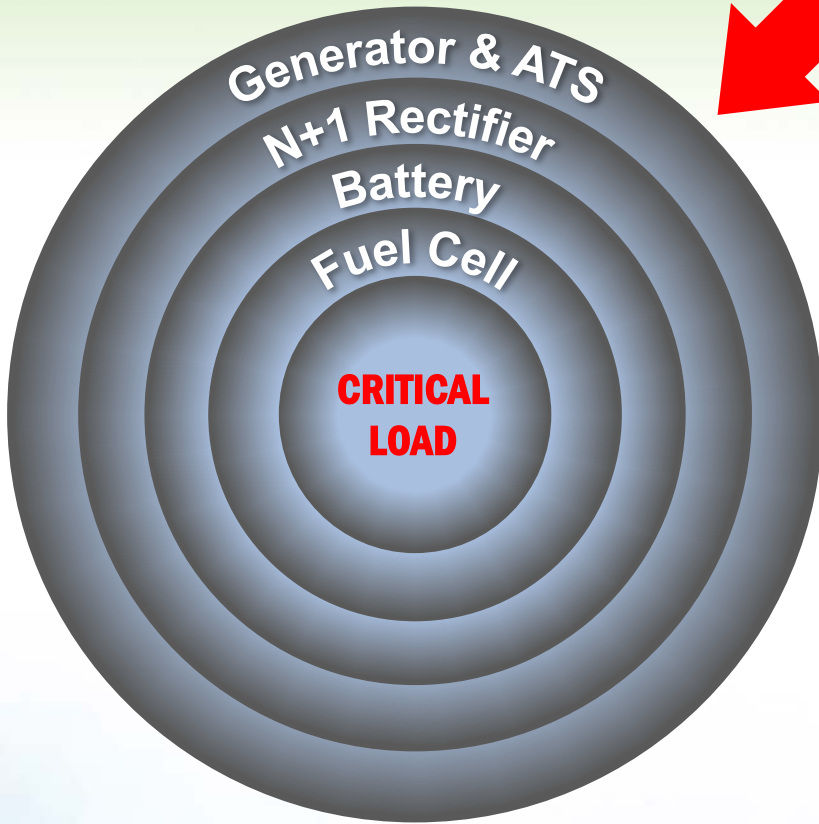
● Climatological events  
(Extreme temperature, drought, wildfire)

# Reported Outages 2014



Source: "Blackout Tracker Annual Report," by Eaton Corporation.

# Redundant & Resilient Power



**Resilience:** The ability to resist, absorb, recover from or successfully adapt to adversity or a change in conditions.

*Department of Homeland Security, Risk Lexicon 2008*

# GenFuel Hydrogen Supply Solutions



- High Pressure Gas Transport Modules
  - 85 kg of H<sub>2</sub>
  - 1,300 kWh of Hydrogen Storage
- Refill model or add-on storage
- 3<sup>rd</sup> Party Service Providers



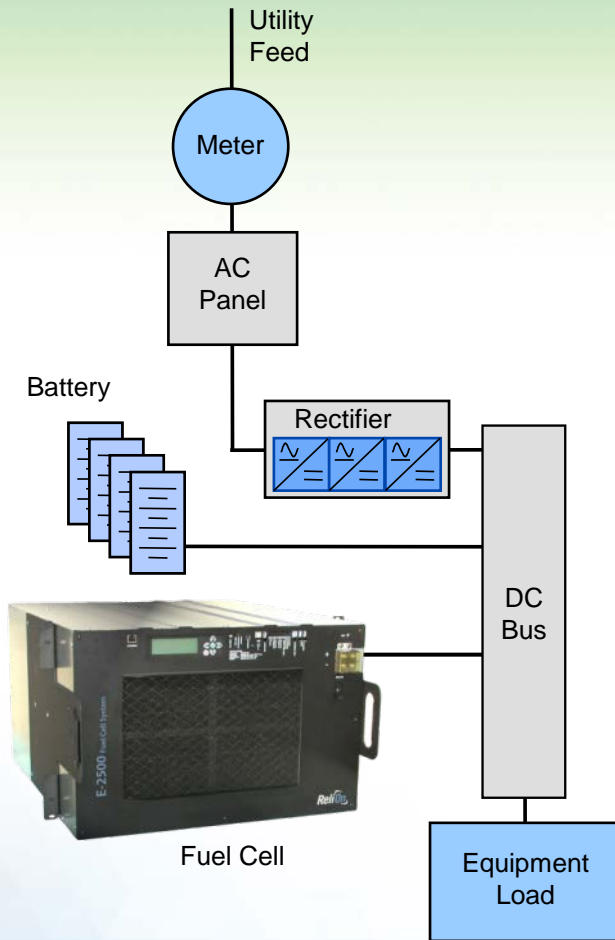
- Multipack Replacements
  - 12/16/18 pack
- Low initial investment
- Delivered when required
- Simple picker truck



- Micro Bulk Truck
  - 200 kg of H<sub>2</sub>
- Bulk Refill
- Pressure Equalization
- Up to 400kWh storage



# Site Power System



- Simple DC Bus Connection
- Connects on the Load Side of Meter
- Parallel to Battery and Rectifier
- Fuel Cell Dimensioned for Power
- Hydrogen Dimensioned for Energy
- Indoor or Outdoor Mounting
- Load Following
- Fault-Tolerant
  
- Efficiency and Power Reduction
  - New technology in telecom gear
  - More efficient power conversion
  - Cooling solutions

Simple maintenance and fewer site visits mean up to 84% lower operational costs when compared to combustion generators.

# Typical Outdoor Installations

- Pad/Platform Mounting
- Cylinder Exchange or Refillable
- No Emissions



# Typical Indoor Installations

- Shelter or Equipment Room Fuel Cell
- Indoor or Outdoor Fuel Storage
  - Indoor: No external impact to site
  - Outdoor : Simple Fueling & Maintenance Accessibility
- No Emissions

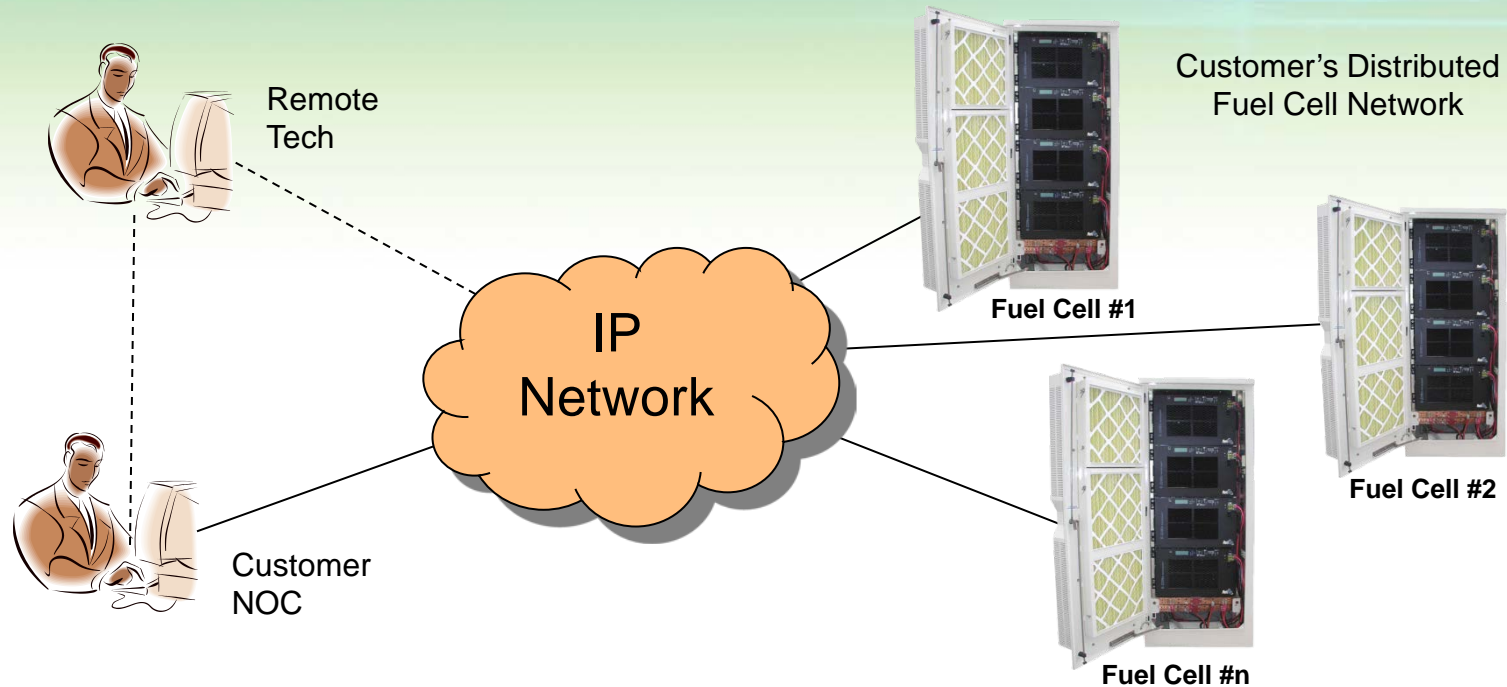


# Mobile & Hybrid Power Systems

- Power On Wheels
  - May be power only or power w/ communications
  - Purpose designed for disaster recovery and temporary communications
- Hybrid Power
  - Fuel Cell/Solar/Wind/Battery/Genset Hybrid
  - Fuel Cell can support intermittent alternate energy



# Remote Operations



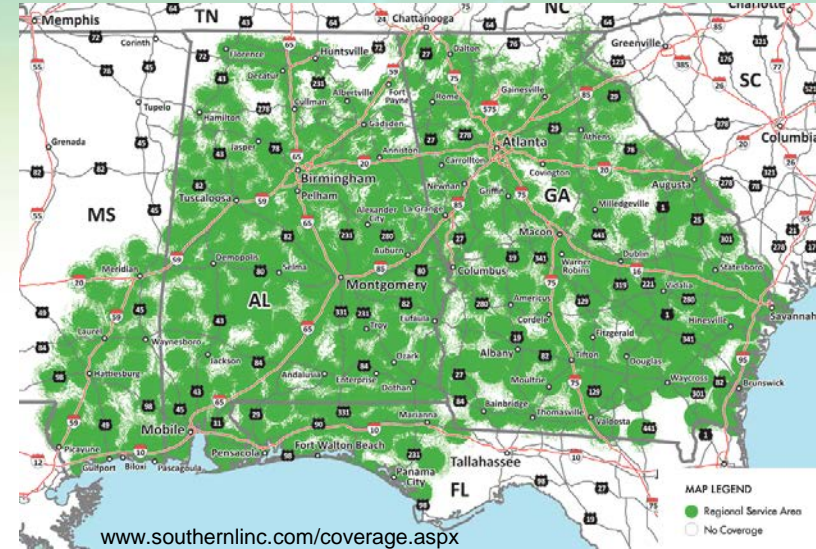
## Monitoring

- Remote Activation
- M2M via SNMP
- Active Fuel Level Monitoring
- Active Alarm Monitoring
- Remote Testing

## Connectivity

- Ethernet/IP Network
- USB
- Modem – per Operator standards  
CDMA/GSM/GRPS
- Adaptors
- Local Display

- Wireless communications network backed by the strength and reliability of Southern Company
- Provides reliable wireless communications service, including mobile phones, to a wide range of businesses and consumers within a 127,000 square-mile coverage area that includes Alabama, Georgia, southeastern Mississippi, and the Florida Panhandle



Since day one, SouthernLINC Wireless built in redundancies, power back-ups and security features designed to deliver consistent communications, even during severe weather conditions. The SouthernLINC Wireless network is built to weather-grade specifications, including reinforced cell sites designed to withstand winds up to 120 mph along the coast and heavy rain and ice loads in the northern part of its footprint. The company has a proven track record of providing reliable communications during and after several major tornadoes and hurricanes, including Erin, Opal, Ivan and Katrina.

# Integrated LTE Solution Drivers

- **Capital Cost & TCO**
  - Lower capital expense for backup power equipment
  - Reduced maintenance of fuel cell relative to combustion generators
- **Reduced Footprint**
  - Lower ground space lease cost – recurring expense
  - Greater applicability to larger number of existing tower locations
- **Speed to Deploy**
  - Permitting challenges increasing for combustion generators
  - Simplified deployment
  - Reduction of on-site backup power integration / expense
- **Enhanced Intelligence**
  - Integrated SNMP monitoring/alarming
  - Integrates w / IP based radio equipment



**Integrated solution equips telecommunications customers with a reliable single cabinet solution for their network power and communications equipment, providing customers with a reduction in capital and operational expenses at each site.**

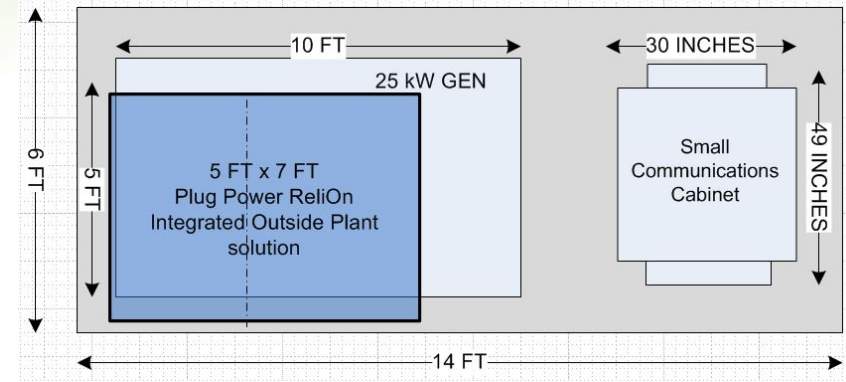
# Integrated LTE Solution



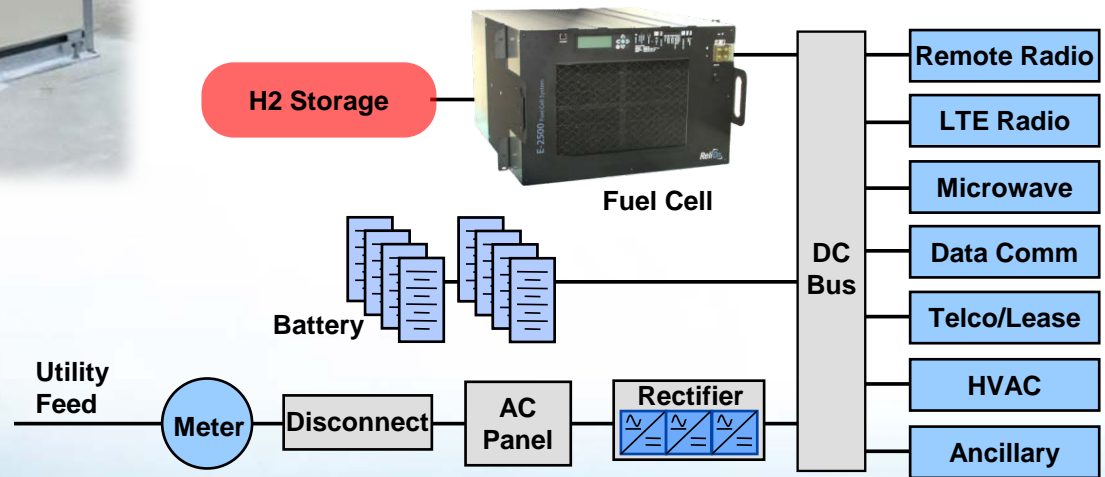
**Integrated Cabinet  
2 Environments**  
Upper Compartment:  
HEX  
Lower Compartment:  
Ventilated

**HSM-16  
300 kW-hr**  
  
**5 day runtime @  
2.5kW load**

## Site Footprint Improvement



## System Configuration



136 communications sites

8 regional dispatch centers

VHF conventional wideband analog  
transitioning to P25 operation

Predominately microwave backhaul

- 600 channel analog looped systems
- DS3 Point to Point digital microwave
- OC3 ATM ringed digital microwave

Primary service provider for state,  
federal, tribal, and local public safety  
agencies



Photo: [www.komonews.com](http://www.komonews.com)

# Problem Definition

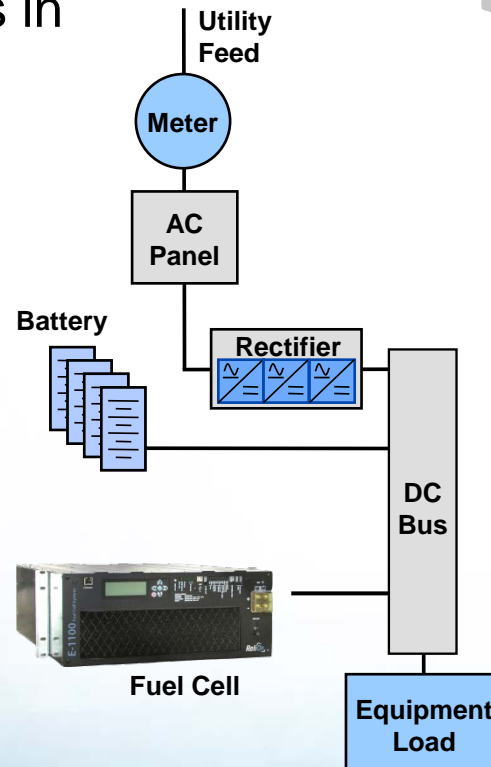
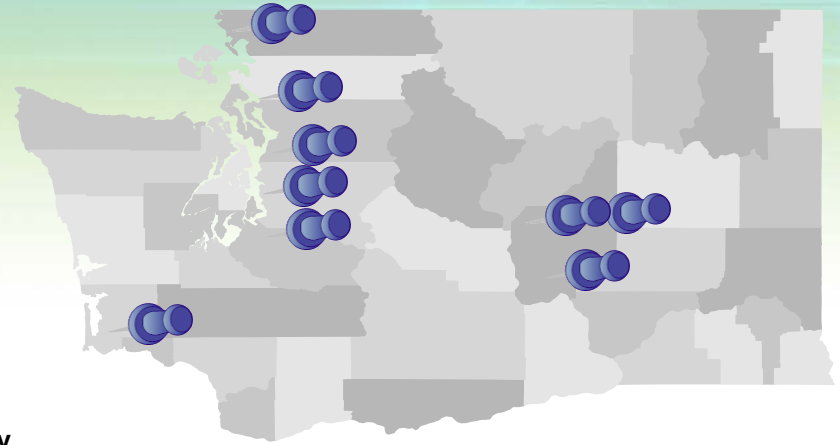
- **Washington State**
  - Geography ranges from 14,000 ft. mountains and rainforests to farmlands and semi-arid desert
- **Batteries**
  - Reaching end of life
  - Space constraints in shelters
- **Desire to investigate alternatives that would**
  - Ensure highly reliable power for critical communications network
  - Save valuable shelter space
  - Further WSP's sustainability goals

WSP's Electronic Services Division has replaced traditional lead-acid batteries with hydrogen fuel cells at 15 of the agency's network radio towers across the state. With initially the same startup cost as lead-acid batteries, fuel cells provide WSP with all the same benefits while helping to preserve the environment.

Washington State Patrol Media Release: March 25, 2015

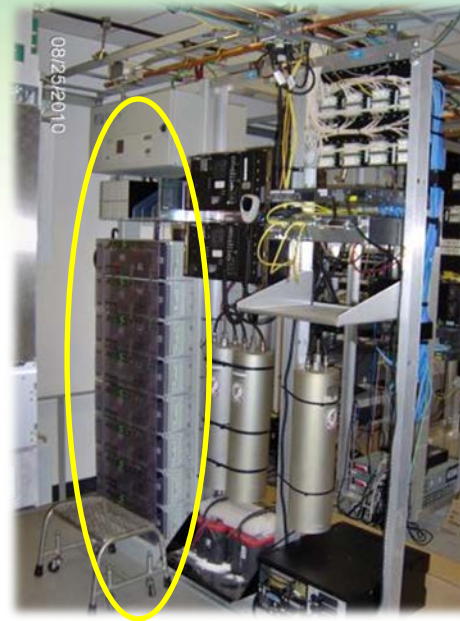
# Solution

- Fuel cells of various configurations to suit the needs of each individual site
- Backup power to grid
- Not a cookie cutter approach
- WSP has installed fuel cells in multiple regions around Washington



# Value to the Customer

- Reliable
- More cost effective
- Low maintenance
- Green in multiple ways
- Scalable
- Saves equipment room space



Before



After

"The transition to the fuel cells was low risk, it worked well and we plan to continue working towards the transition to alternative energy sources," said Bob Schwent, Electronic Services Division Commander. "The fuel cells are very low maintenance, green and low cost." Washington State Patrol Media Release: March 25, 2015

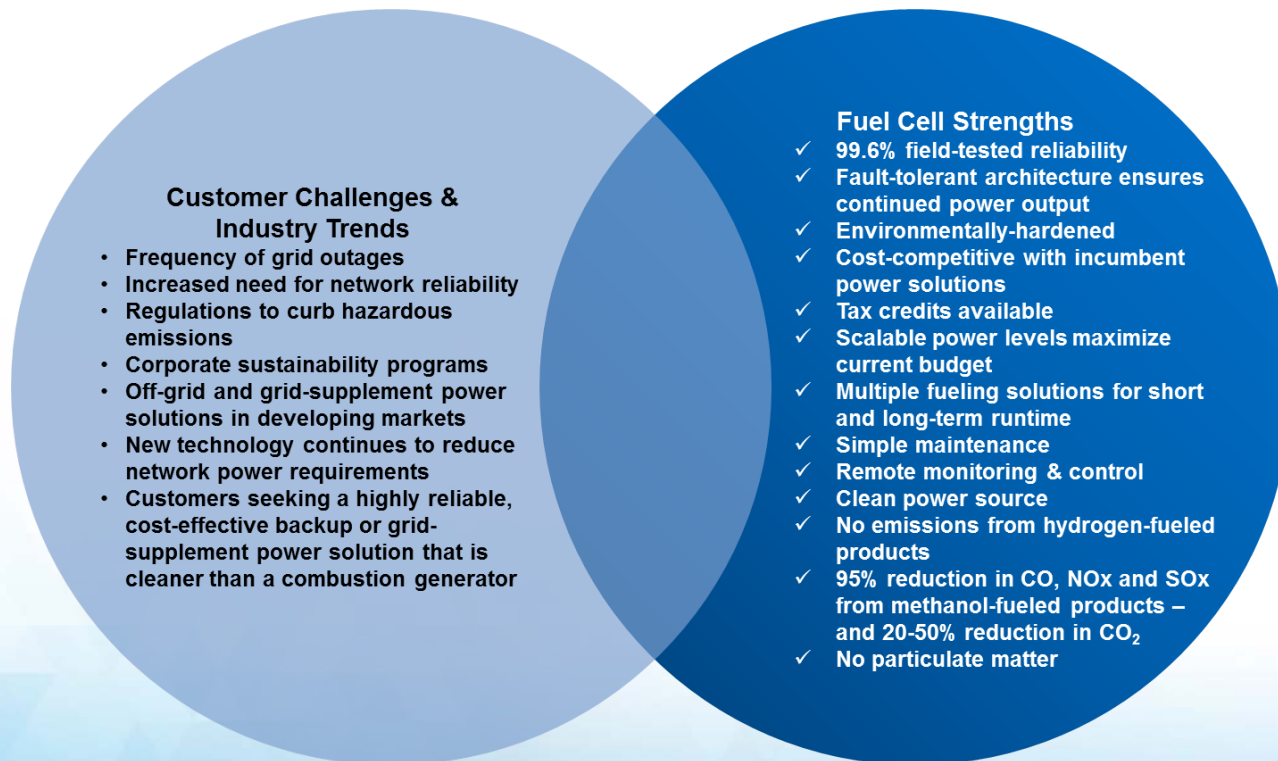
# Commercial Resources

- Federal & State Programs
  - Fuel Cells – 30% or \$3k/kW (whichever is less) of qualifying property as an Investment Tax Credit
  - States: Varies widely – from Sales Tax abatement, to capital offset, to renewable credits
- TIA Working Group
  - Fuel Cell Standards for Wireless and Other Critical Information and Communication Technologies (ICT) Infrastructure  
[www.tiaonline.org/all-standards/exploratory-focus-group-fuel-cell-standards-wireless-and-other-critical-ict](http://www.tiaonline.org/all-standards/exploratory-focus-group-fuel-cell-standards-wireless-and-other-critical-ict)



# Summary

- Hydrogen Fuel Cells
  - Valuable component in a resilient power solution
  - Highly reliable, simple, cost-effective solution for critical remote and off-grid applications
- Field-proven, with thousands of installations





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