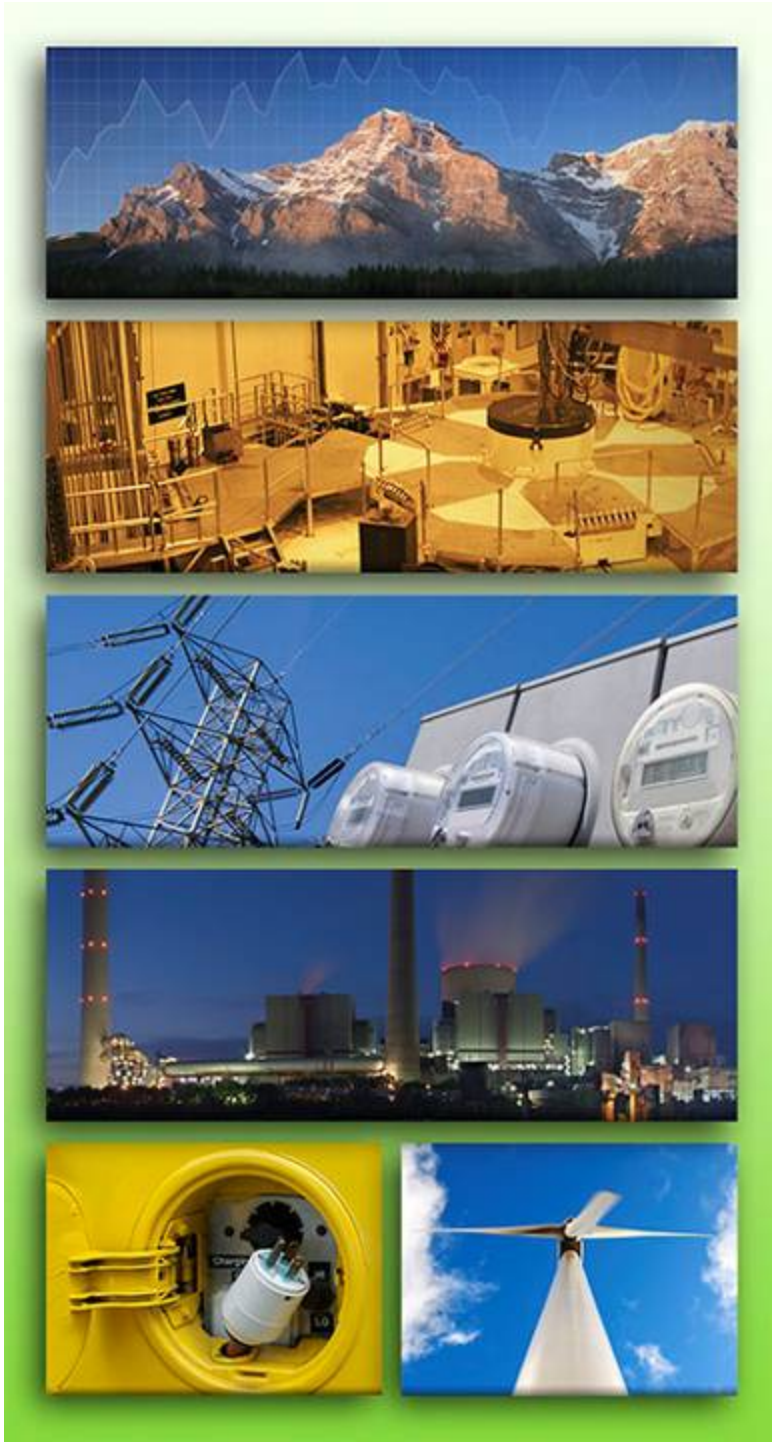

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Next Generation Sensors: Power Industry

Dr. Arshad Mansoor
Vice President, Power Delivery

Government-University-Industry Research Roundtable Meeting
February 22, 2010

The Electric Power Research Institute

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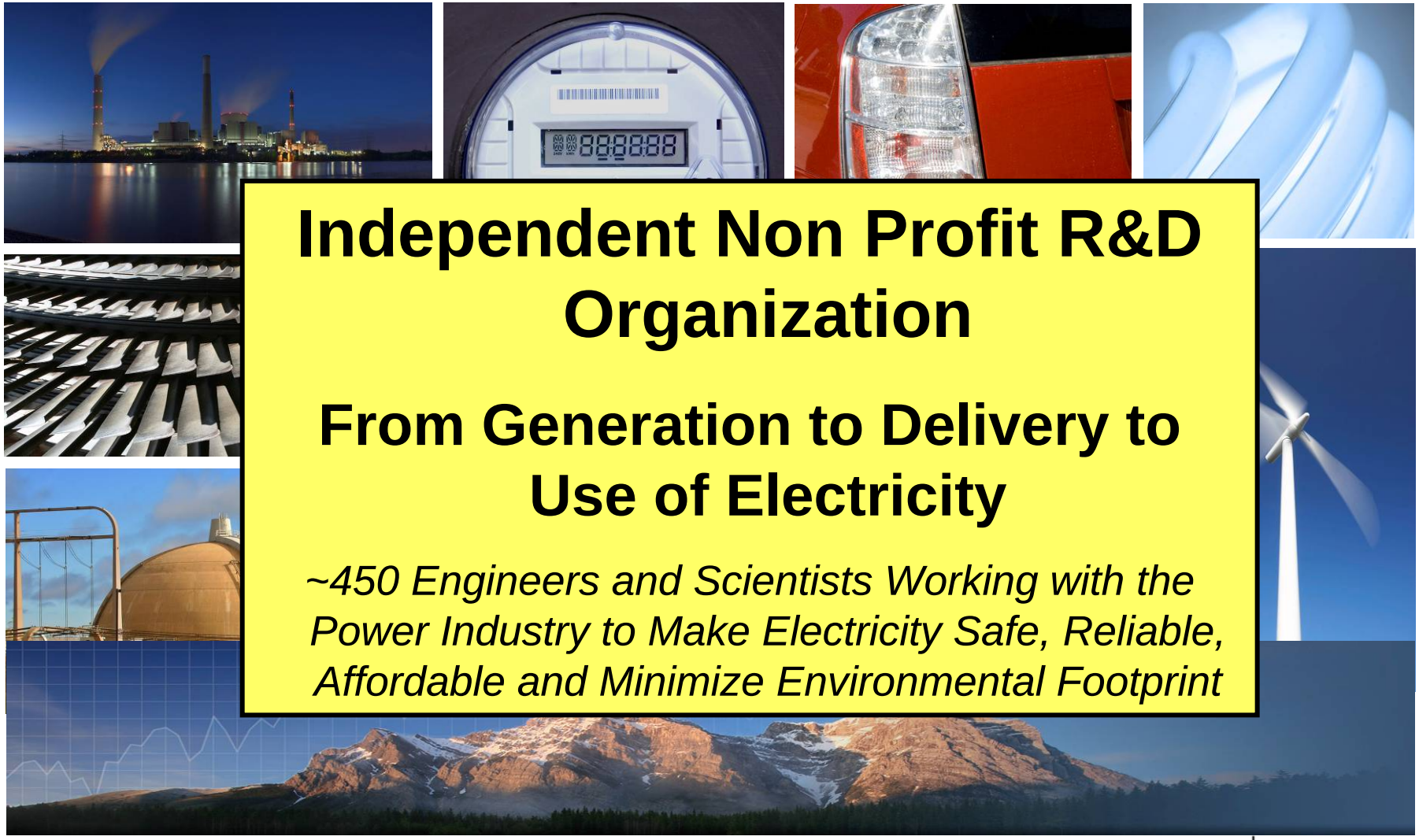
The Electric Power Research Institute



Independent Non Profit R&D Organization

From Generation to Delivery to Use of Electricity

~450 Engineers and Scientists Working with the Power Industry to Make Electricity Safe, Reliable, Affordable and Minimize Environmental Footprint

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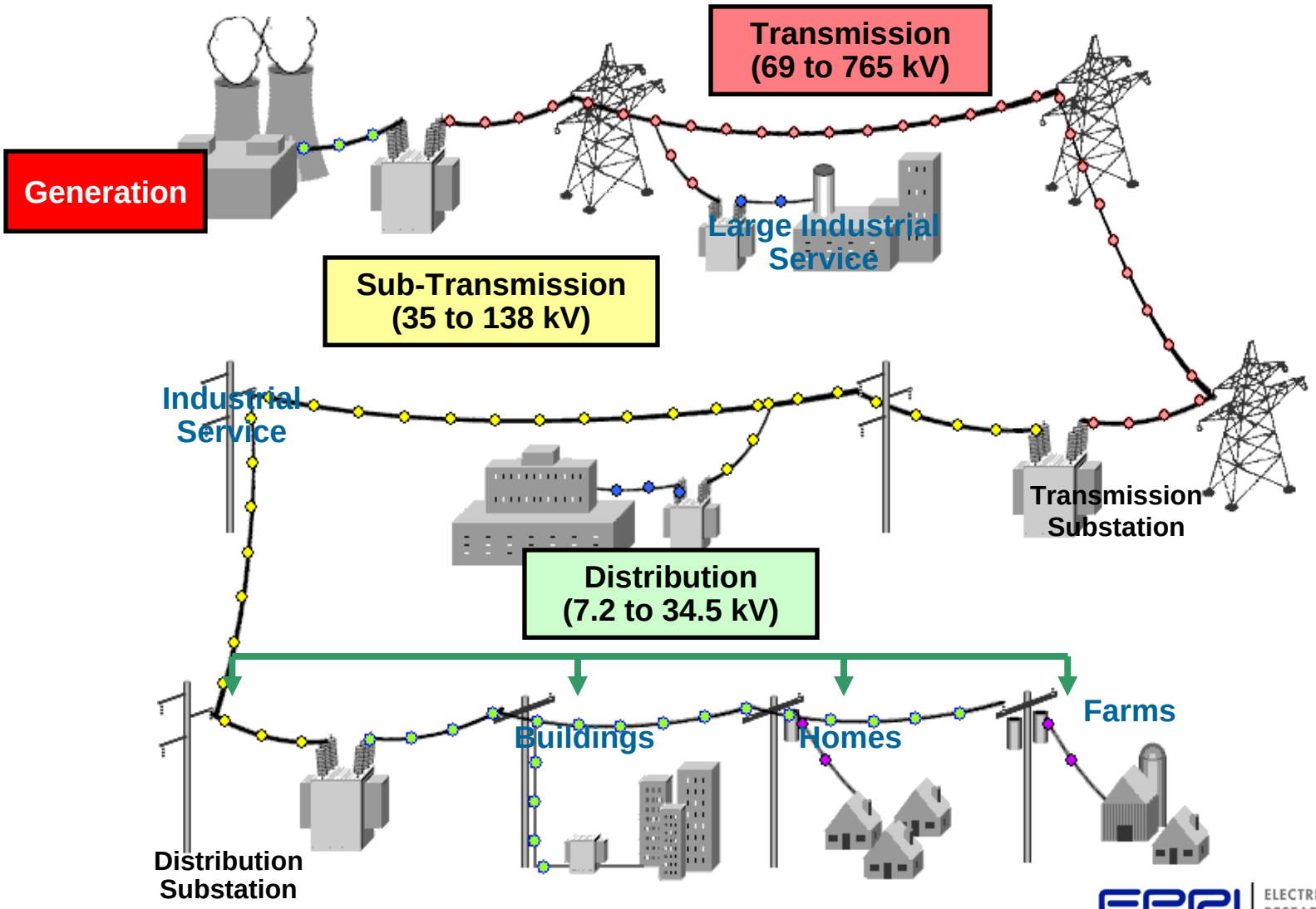
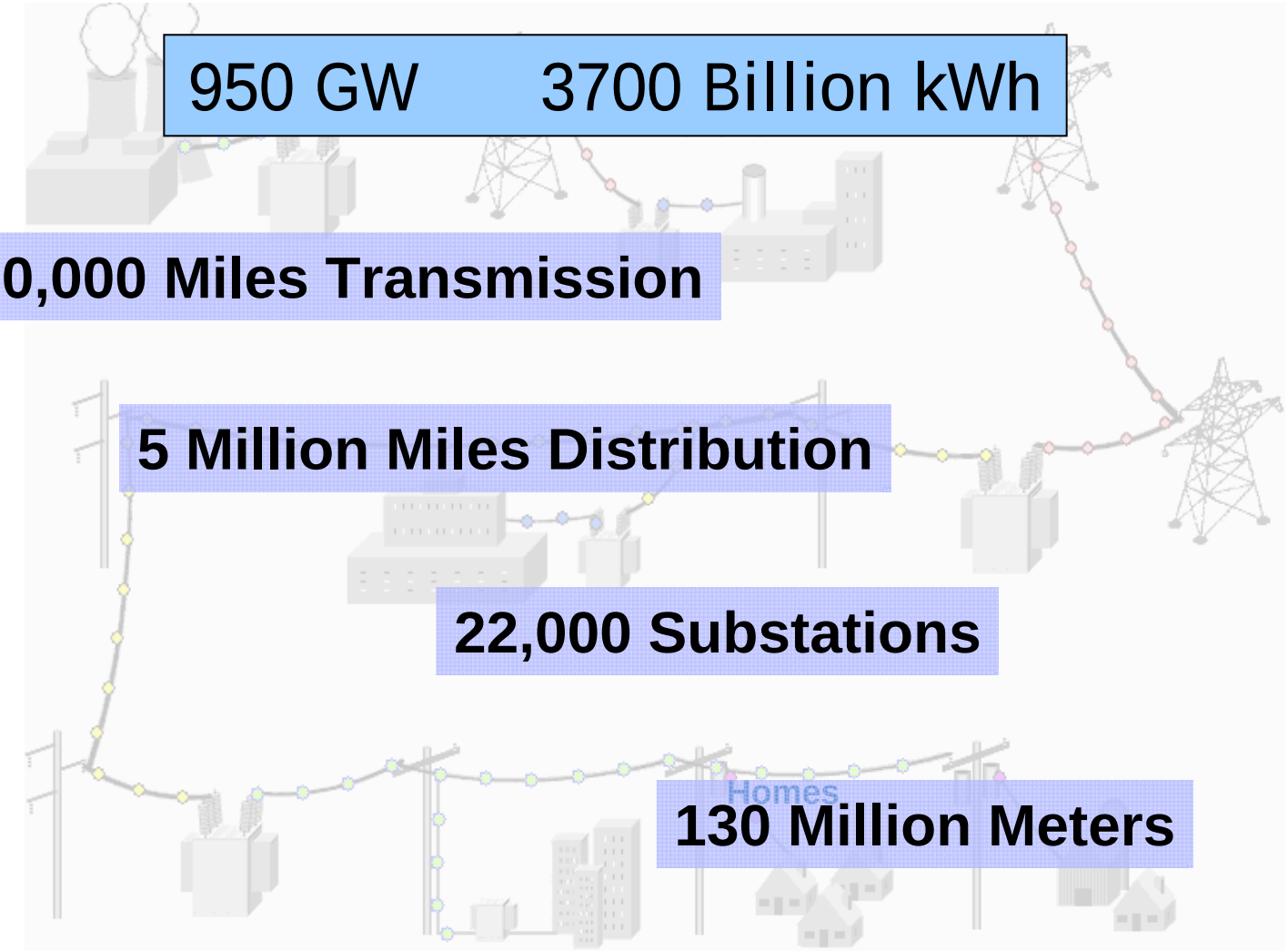
The Power Sector



The Power Sector: Facts



The Evolving Smart(er) Grid

Sense

Communicate

Compute

Control

Power Plants

Transmission

Substations

Distribution

Consumers

Sensors

A Key Component of the Evolving Smart(er) Grid

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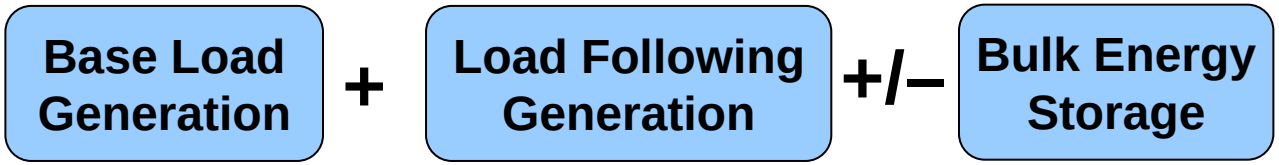
Examples of Future Sensor Needs for the Smart(er) Grid

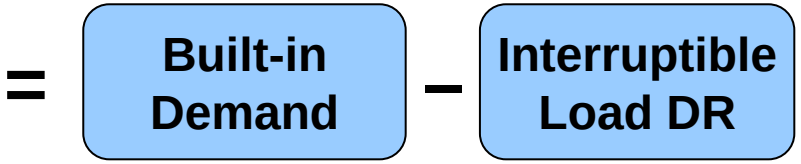
- **The Next Generation Grid Management Systems**

- **A Reliable Power Delivery Infrastructure**

Operating Today's Grid

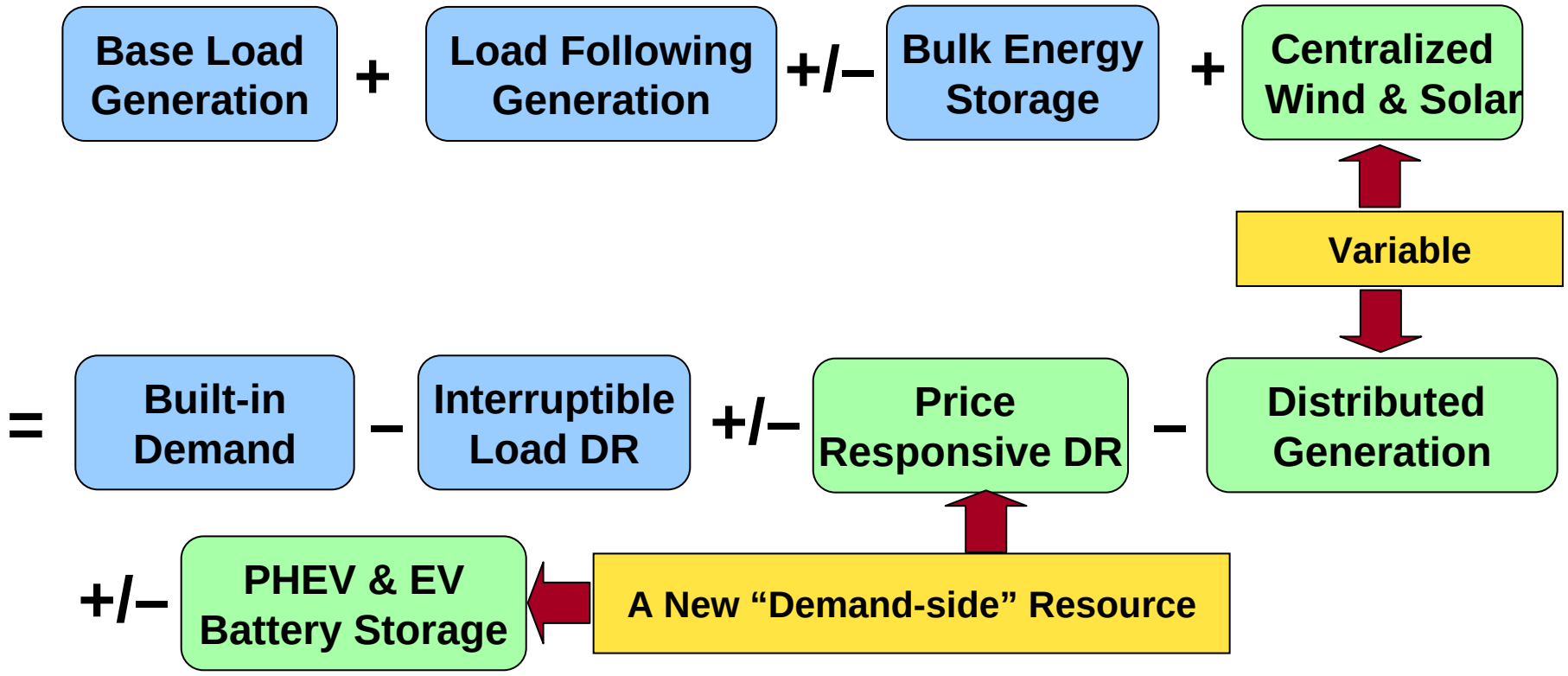
Balancing Forecastable Demand-side Resources with Dispatchable Generation





Operating Tomorrow's Grid

Balancing Unpredictable Demand-side Resources with Variable Generation



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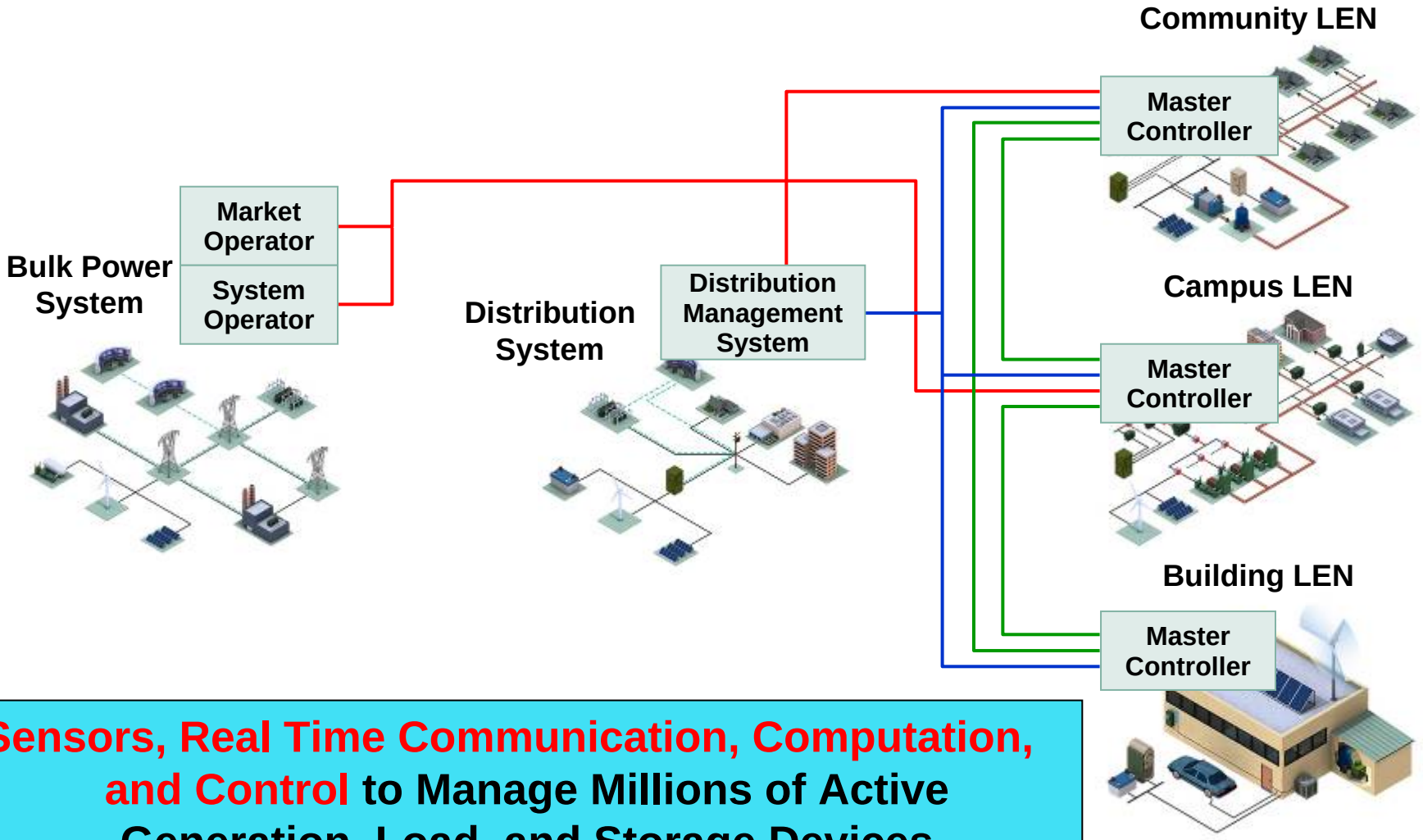
Innovation: Tomorrow's Grid Operating System



Sensors, Real Time Communication, Computation, and Control to Manage Millions of Active Generation, Load, and Storage Devices

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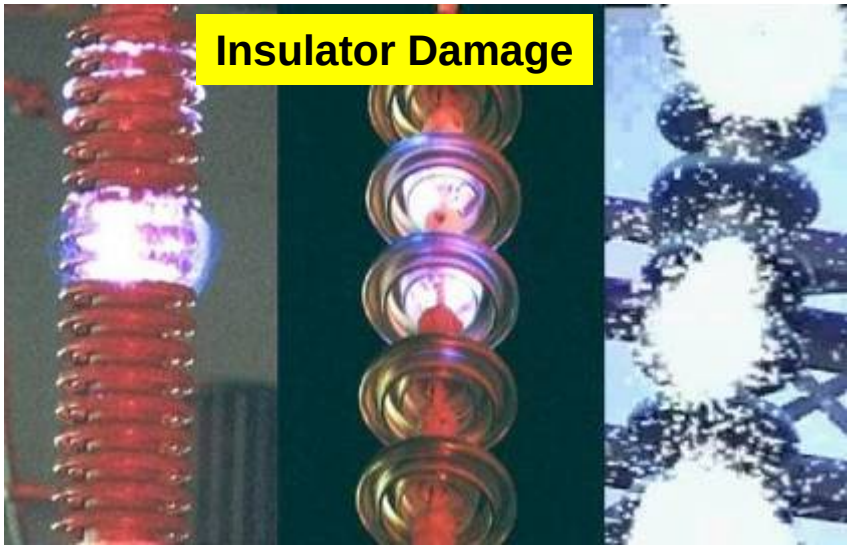
Examples of Future Sensor Needs for the Smart(er) Grid

- The Next Generation Grid Management Systems

- **Reliability Power Delivery Infrastructure**

Reliability of Transmission Infrastrucuture

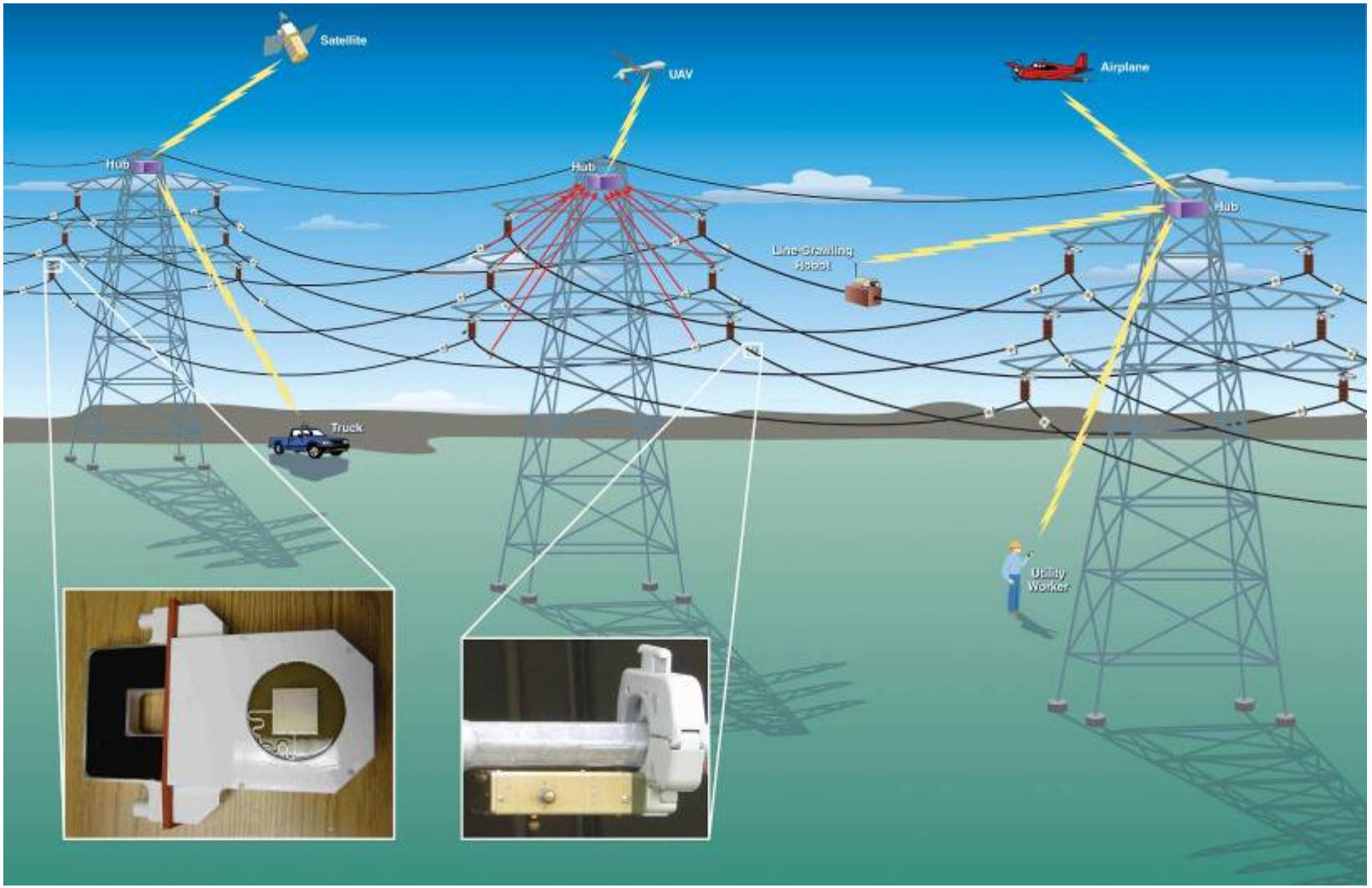
Aging Infrastructure



Corrosion Above Ground Line

Corrosion Below Ground Line

Transmission Line Inspection of the Future



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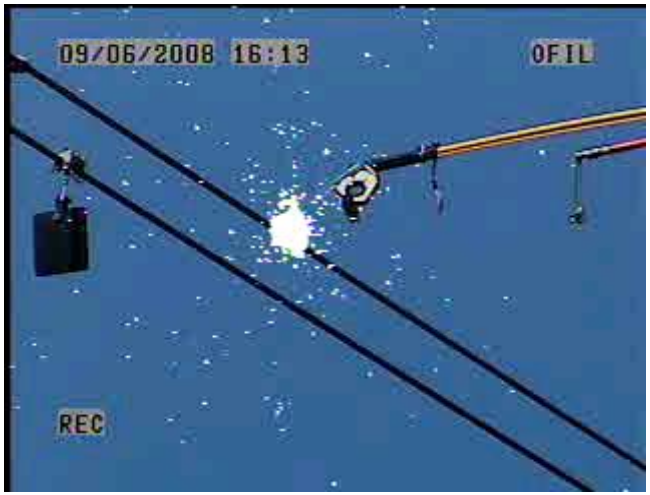
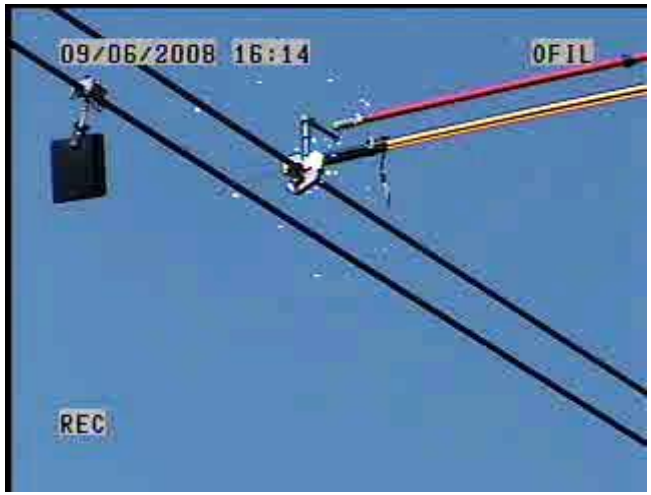
Sensor Challenges – Packaging / Live Working Installation





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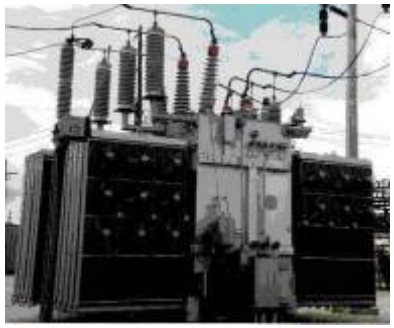
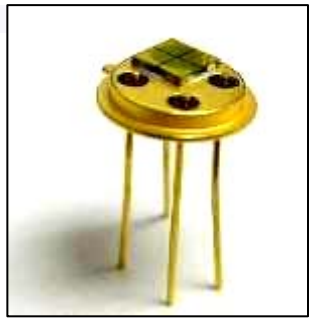
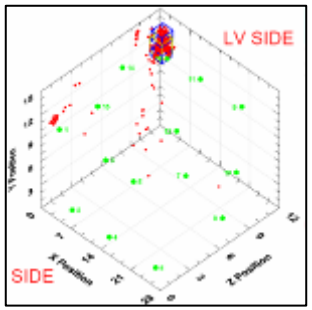
Substations - A Key Infrastructure for the Power Industry

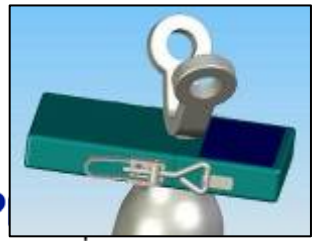
Past



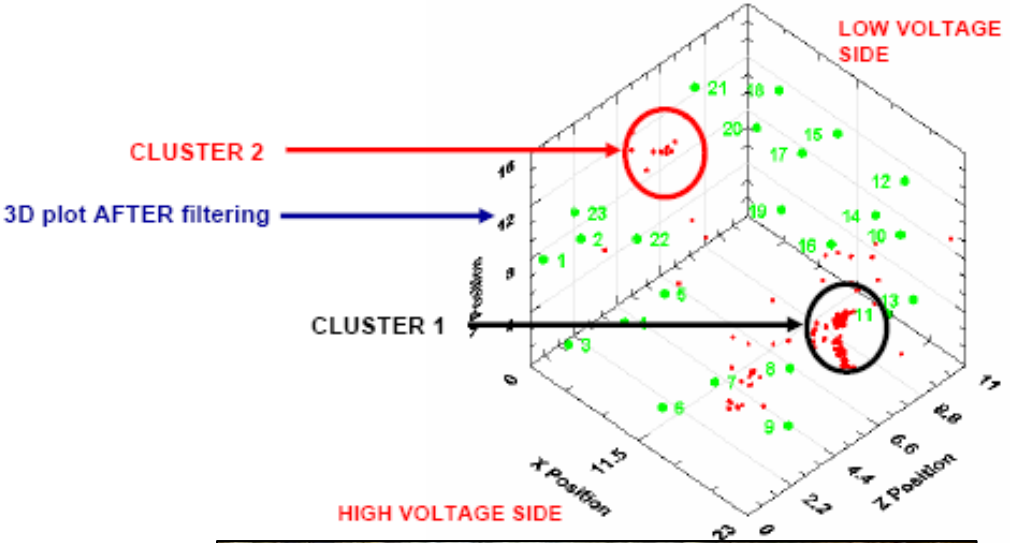
Present to Future…

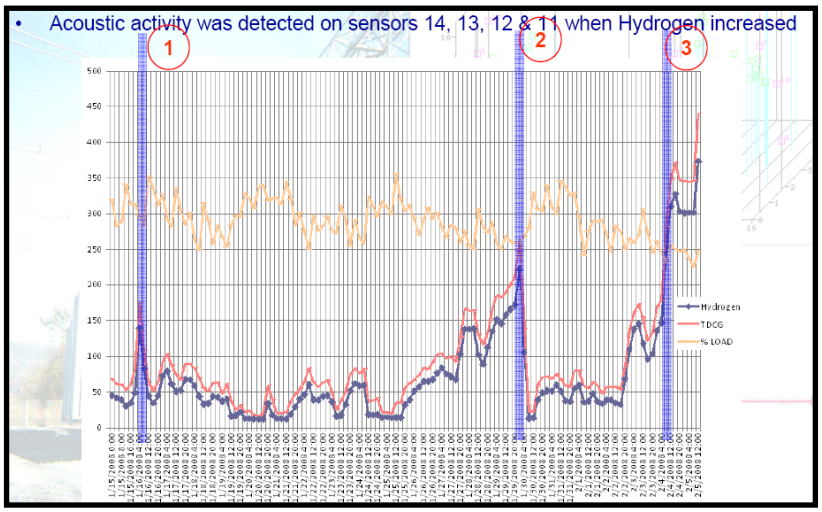


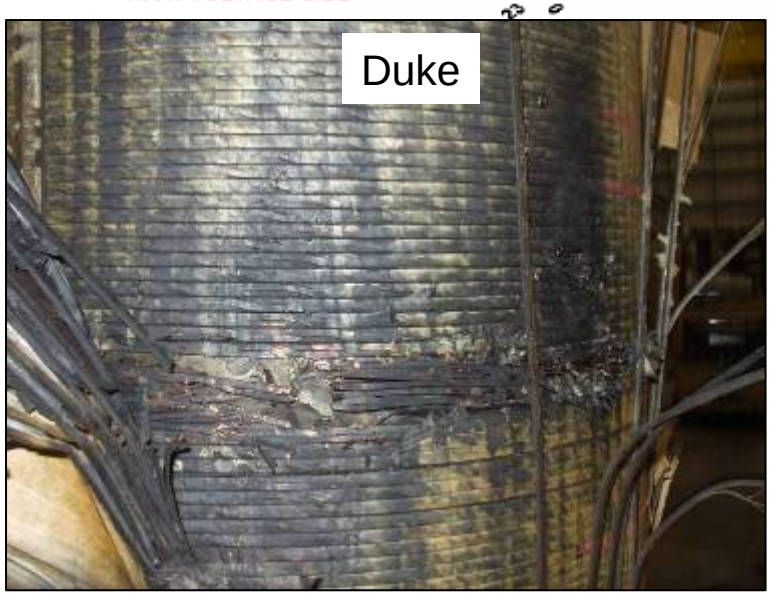




3D Acoustic Emission for Transformers







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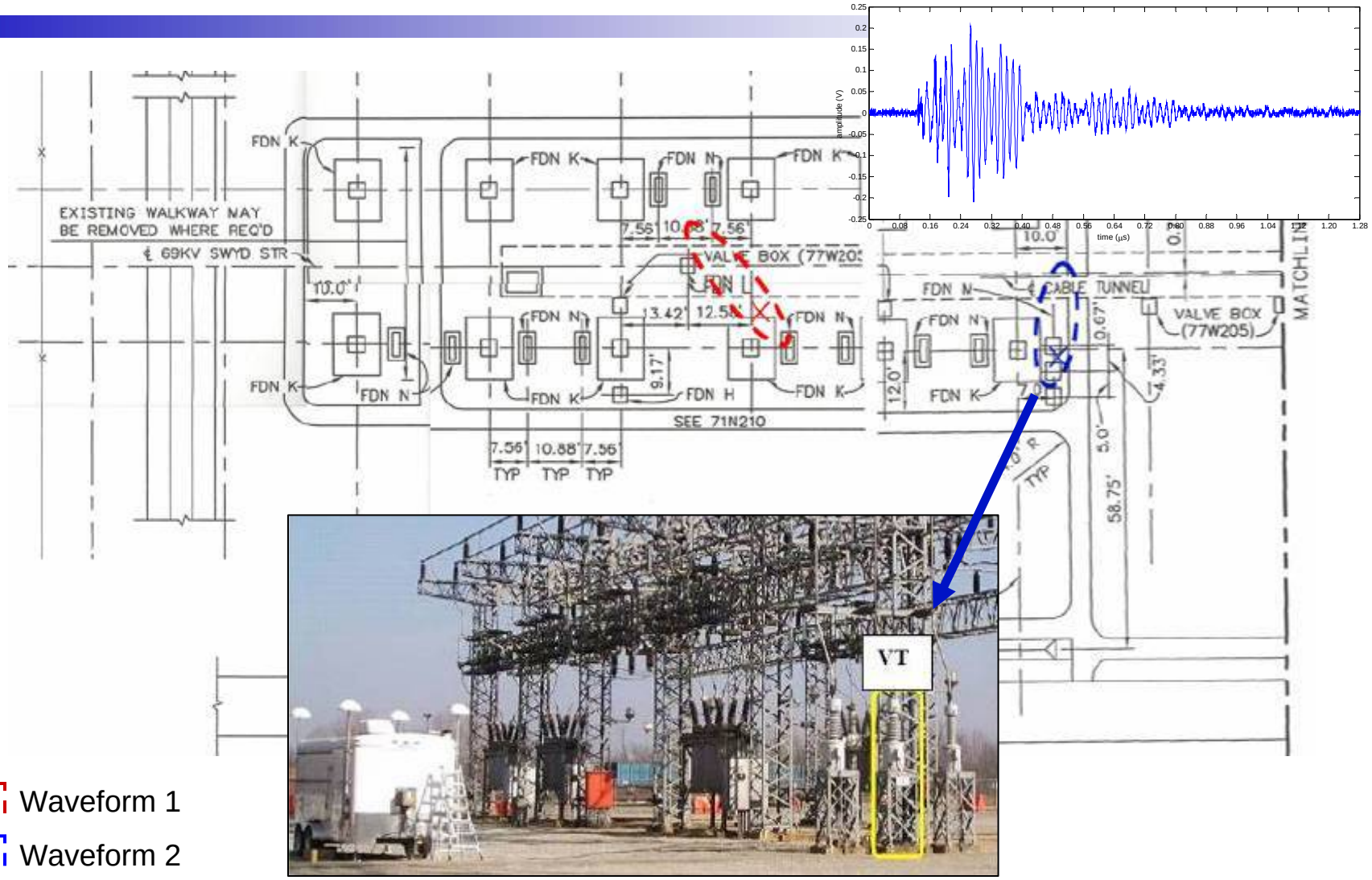
Antenna Array – Discharge Location



Waveform 1

Waveform 2

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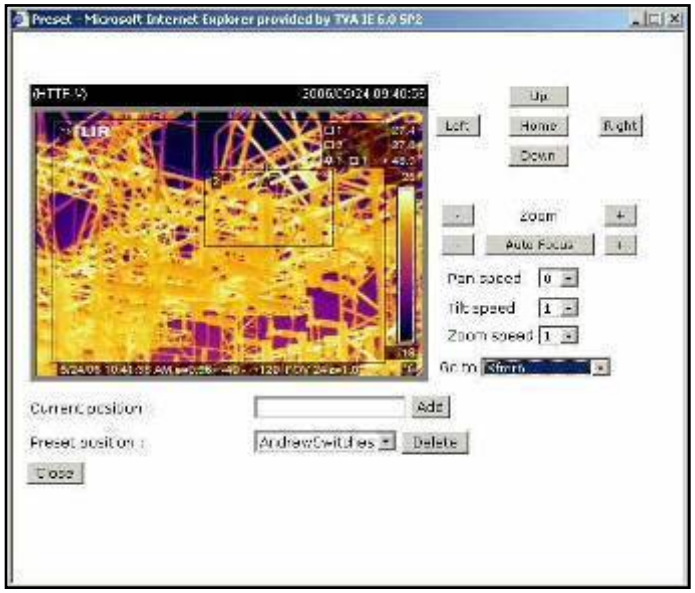
Integrated Monitoring & Diagnostics Algorithm development for on-line IR analysis



High accuracy loggers used for calibration of remote sensing

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Substation Wireless Sensor Research
Vibration Power Harvesting

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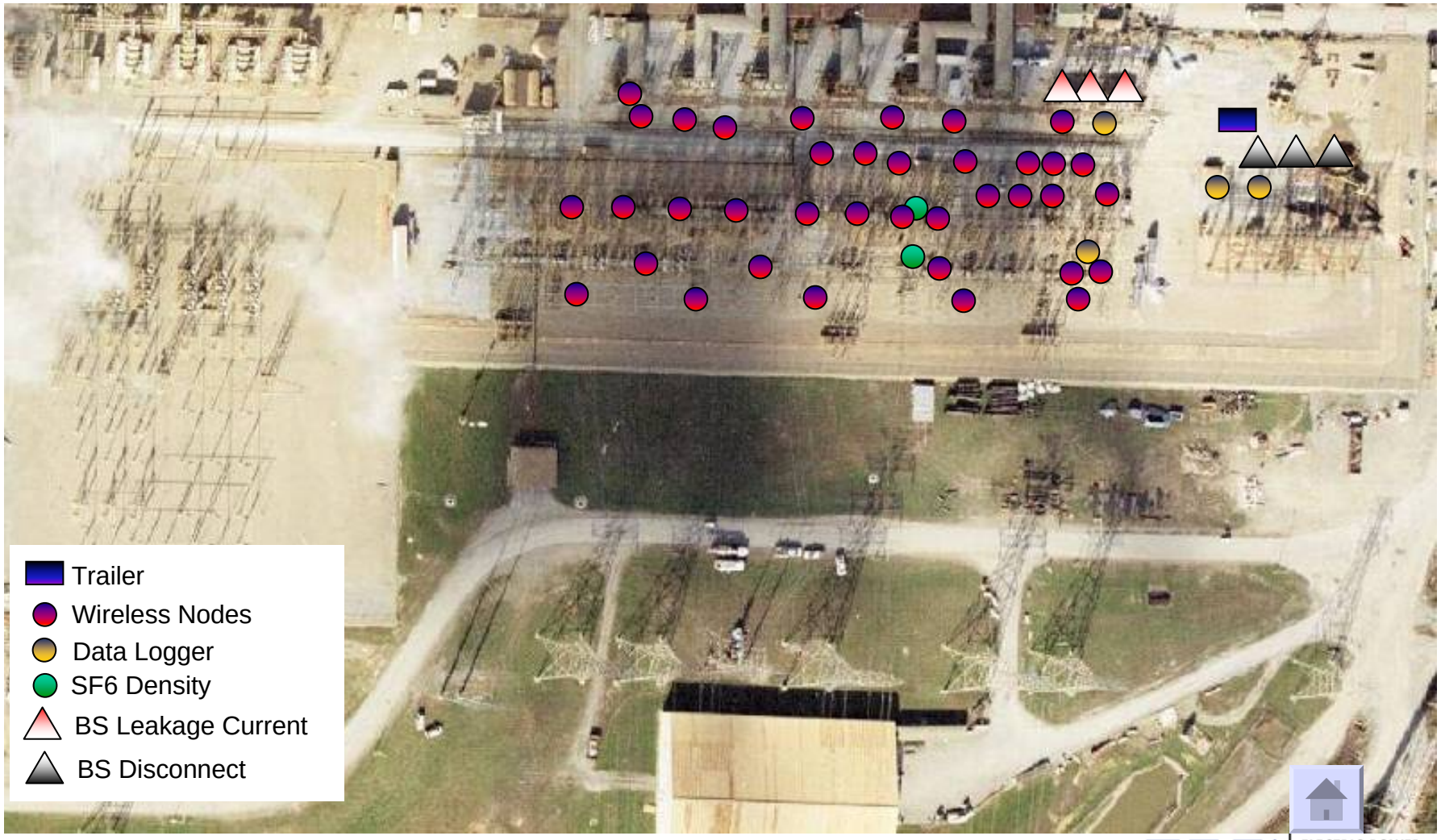
Wireless Mesh Sensors



Field Deployment of Emerging Sensor Technologies – 19 Utilities: 26Sites……Get the Algorithms Right!!

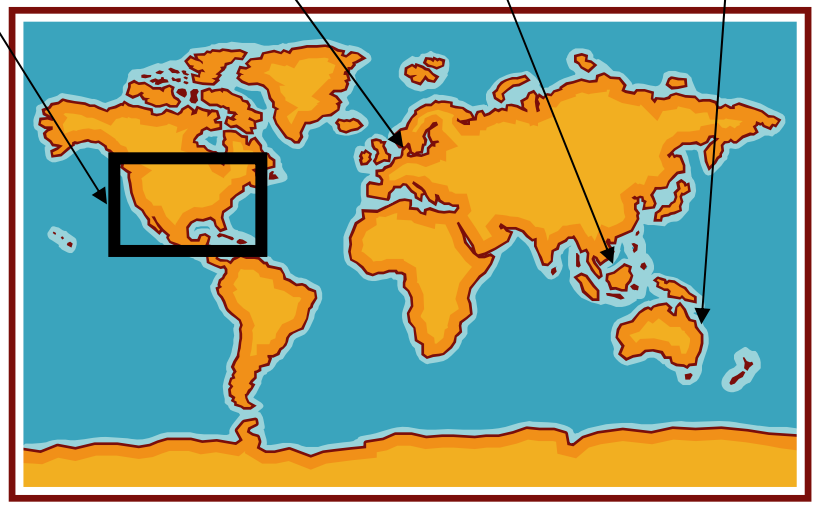
SF6 Density

UK

Malaysia

Australia

16 Utilities



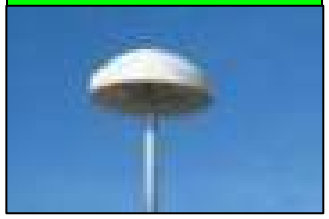
Wireless Acoustics

Contamination Sensor

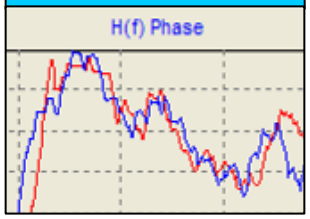
Conductor/ Connector Sensor

Wireless Mesh

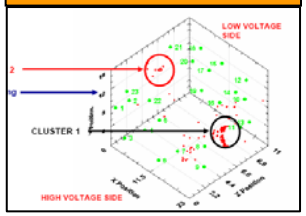
Antenna Array



On-Line FRA



3D Acoustics



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Summary

- Unique needs for sensor technologies in power sector
  - Low cost & maintenance need
  - More reliable than the infrastructure
  - Wide geographical coverage
  - Power harvesting
  - High electrical and magnetic field
  - Uncontrolled environment
- Communication is an enabler
- We soon will be blinded by sensor data…….converting data to information to actionable decision