

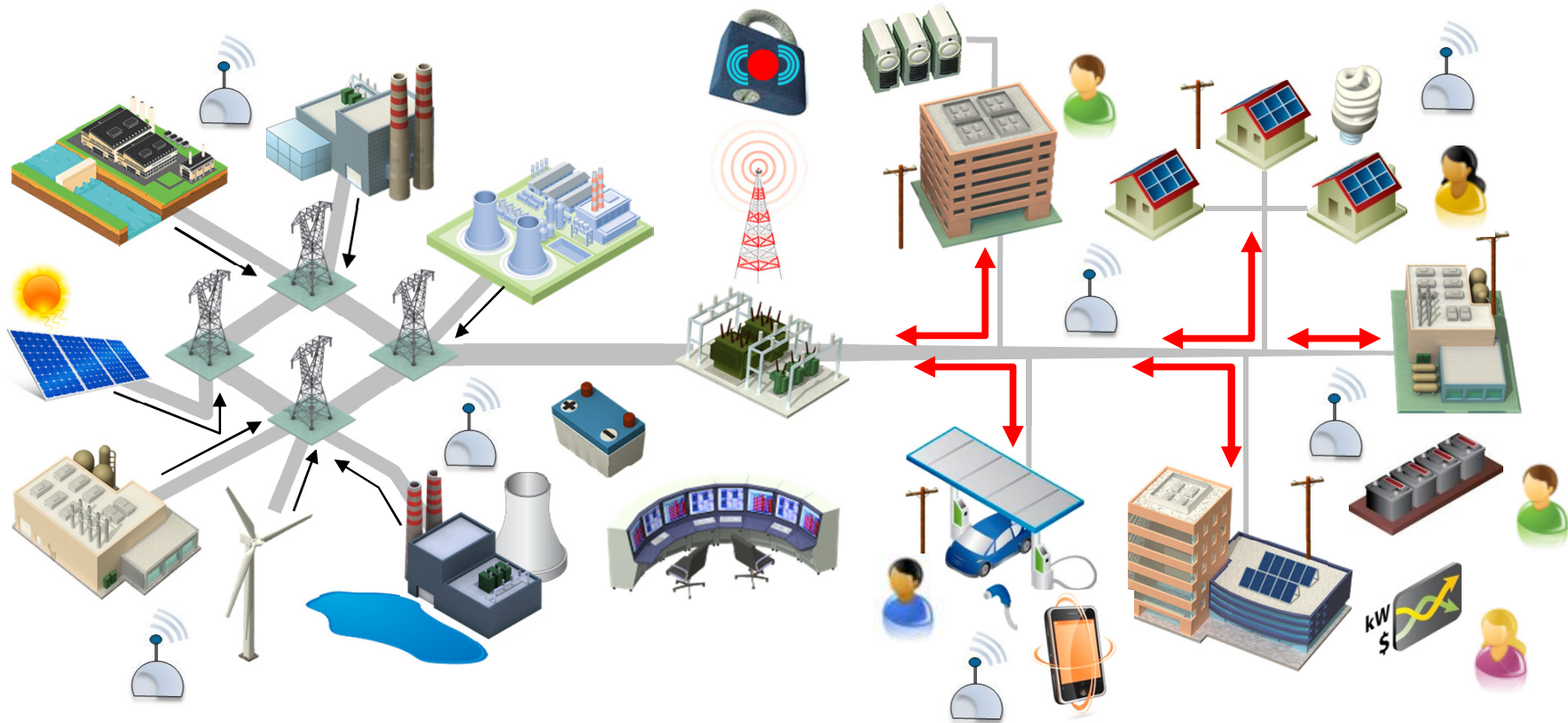
Development of the Smart Grid and Smart Cities – US Perspective

Mark McGranaghan
Vice President, EPRI

2015 CIGRE Workshop
Stresa, Italy
August 27, 2015

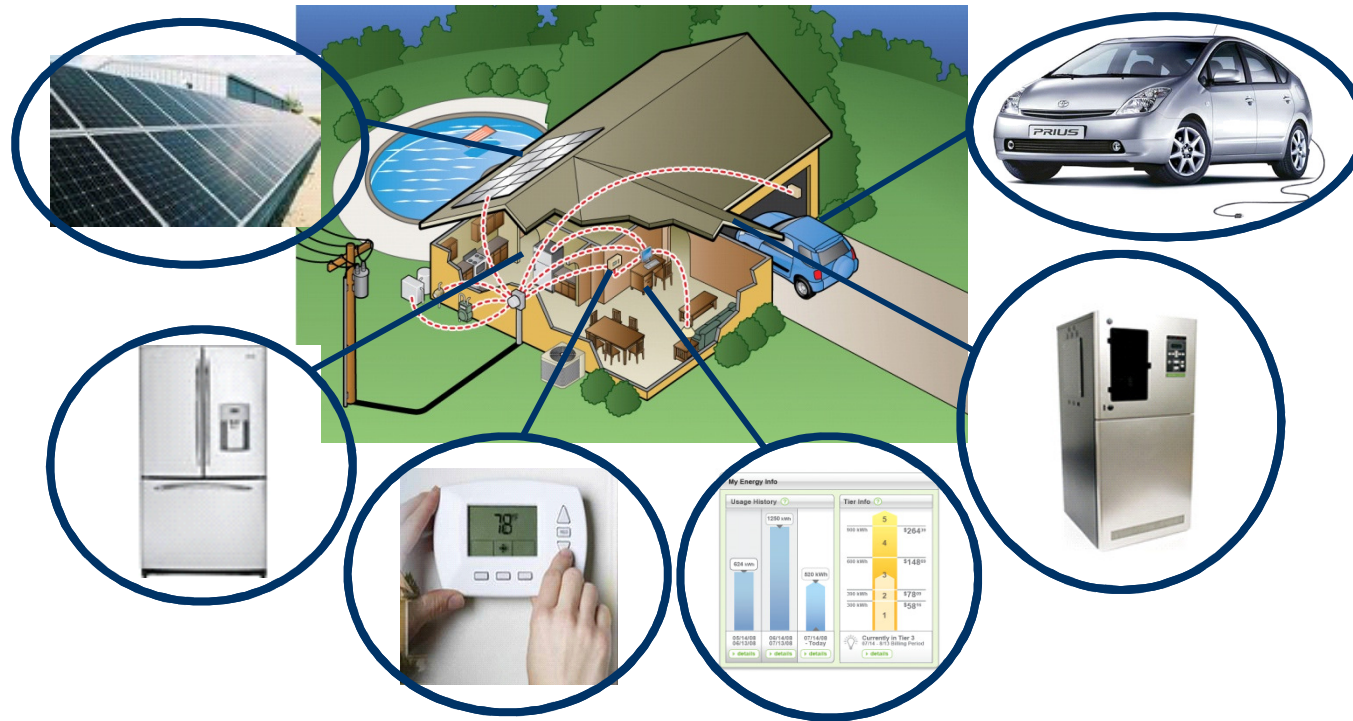


The Vision: An Integrated Grid



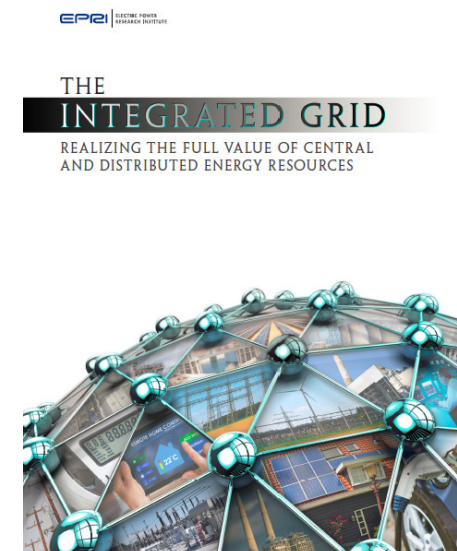
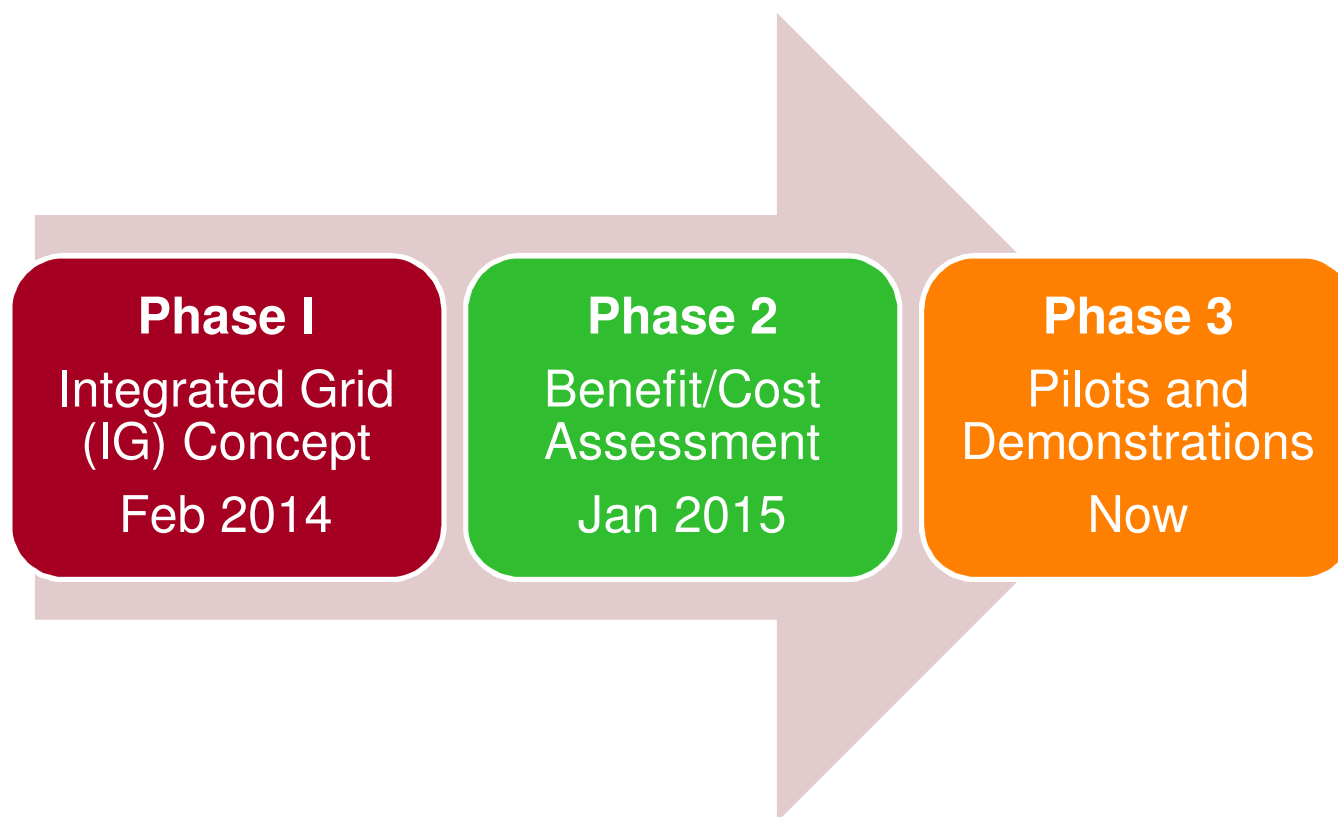
Power System that is Highly **Flexible, Resilient** and **Connected** and Optimizes Energy Resources

The Integrated Grid is about Enabling the Customer



The integrated grid allows **Local Energy Optimization** to become part of **Global Energy Optimization**.

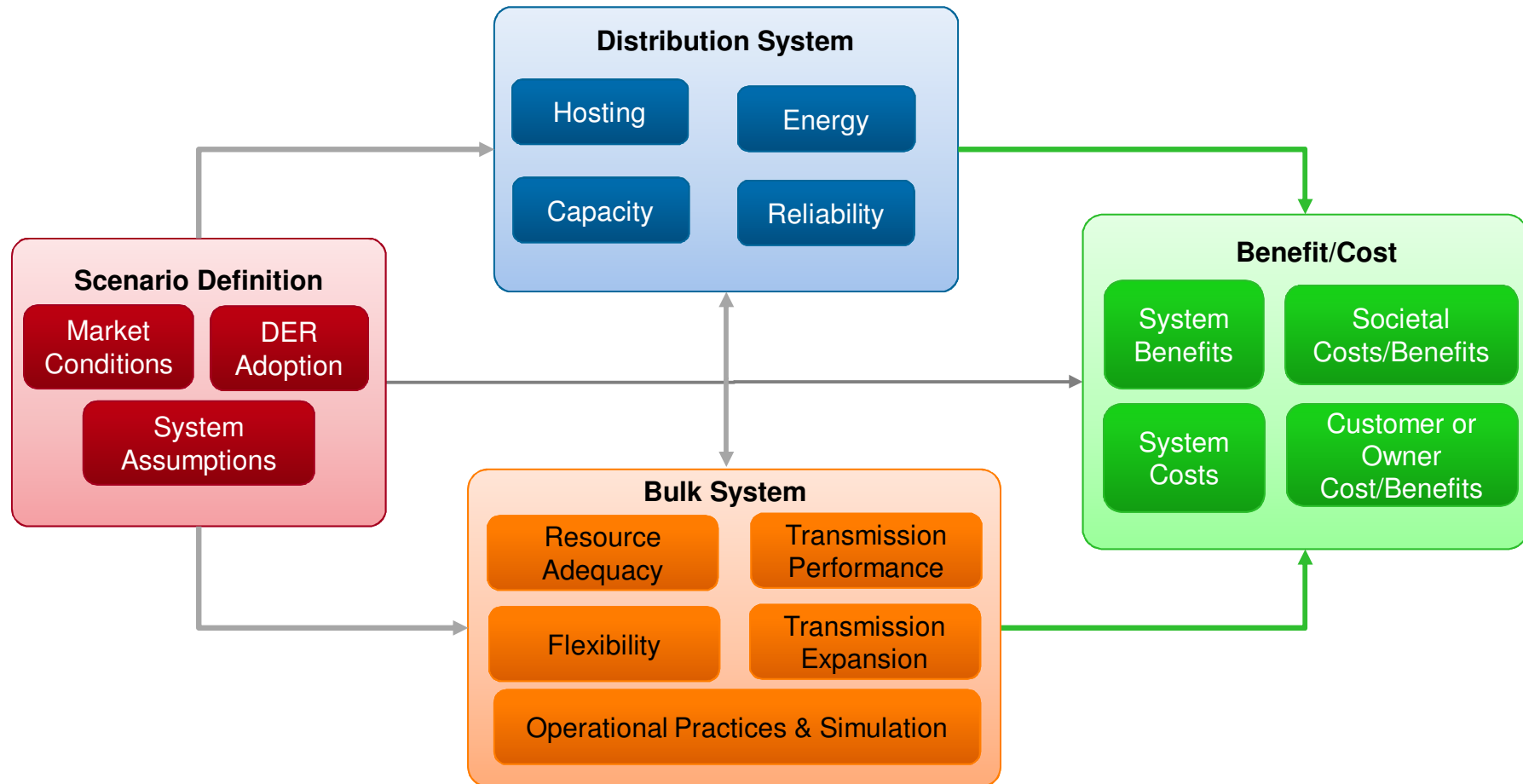
Developing Foundation for an Integrated Grid



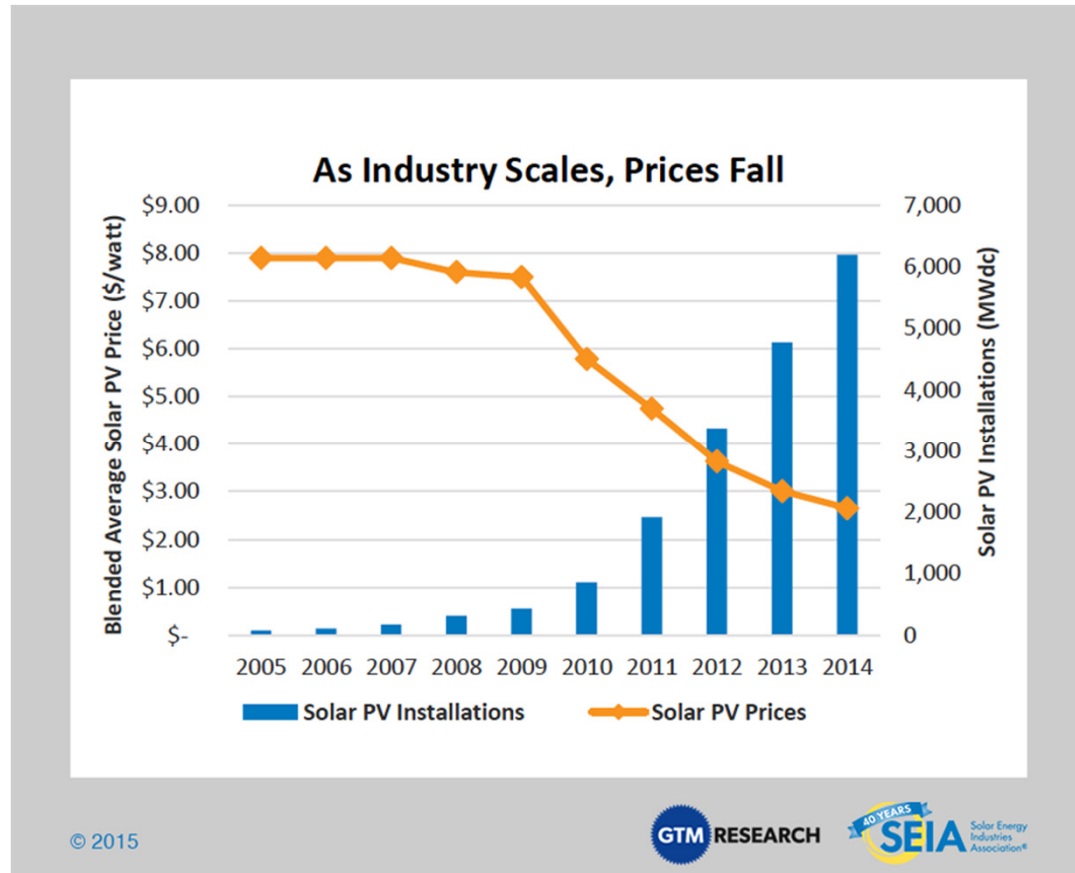
<http://integratedgrid.epri.com/>

Extensive Industry Coordination in All Phases

Overall framework for evaluating integration issues



Game Changer – Distributed Solar



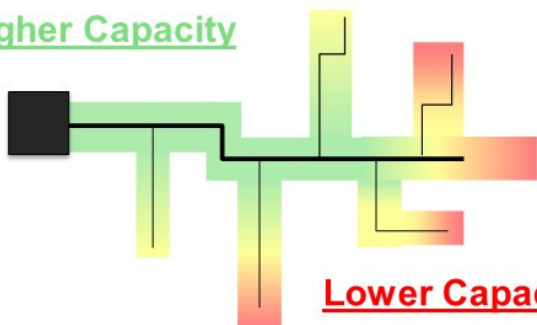
- Germany
- Spain
- Italy
- Australia
- Japan

**Coming Soon: Detailed
Plan On India's 100 GW
Solar Power Ambition**

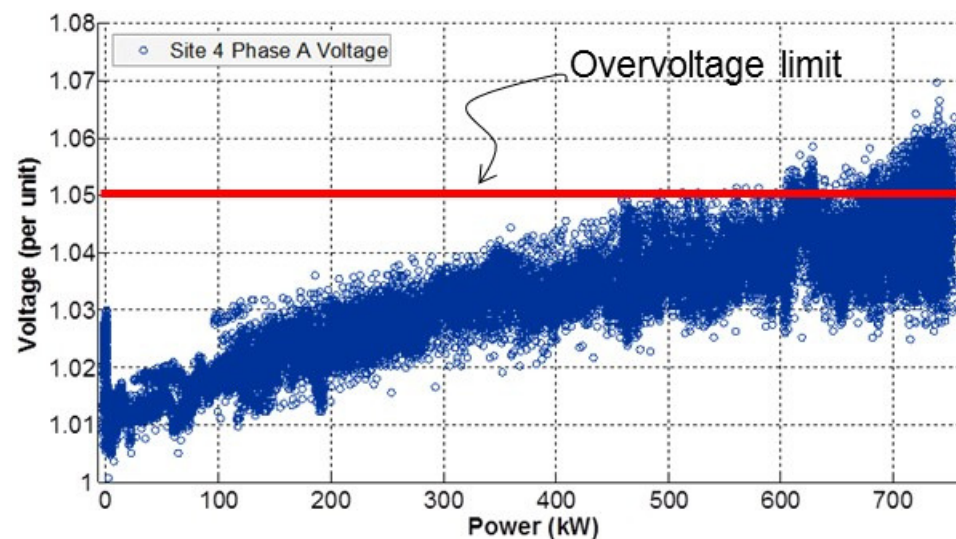
How Much Can We Integrate? – Hosting Capacity

Thermal Rating Limits

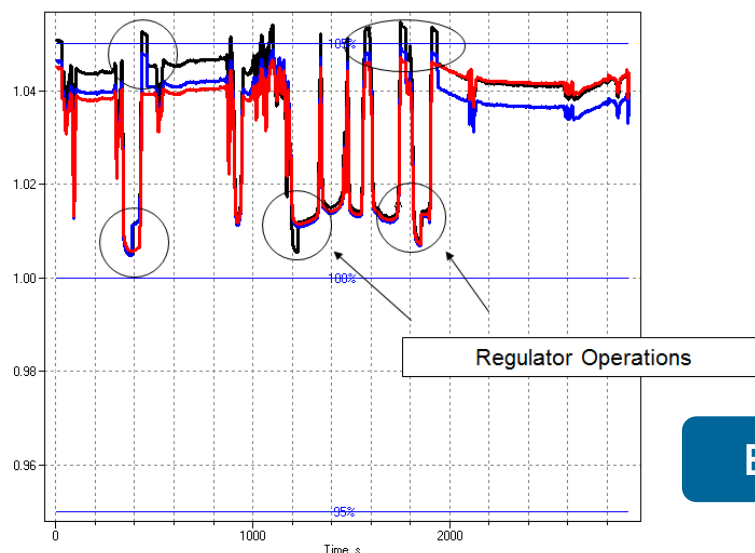
Higher Capacity



Lower Capacity

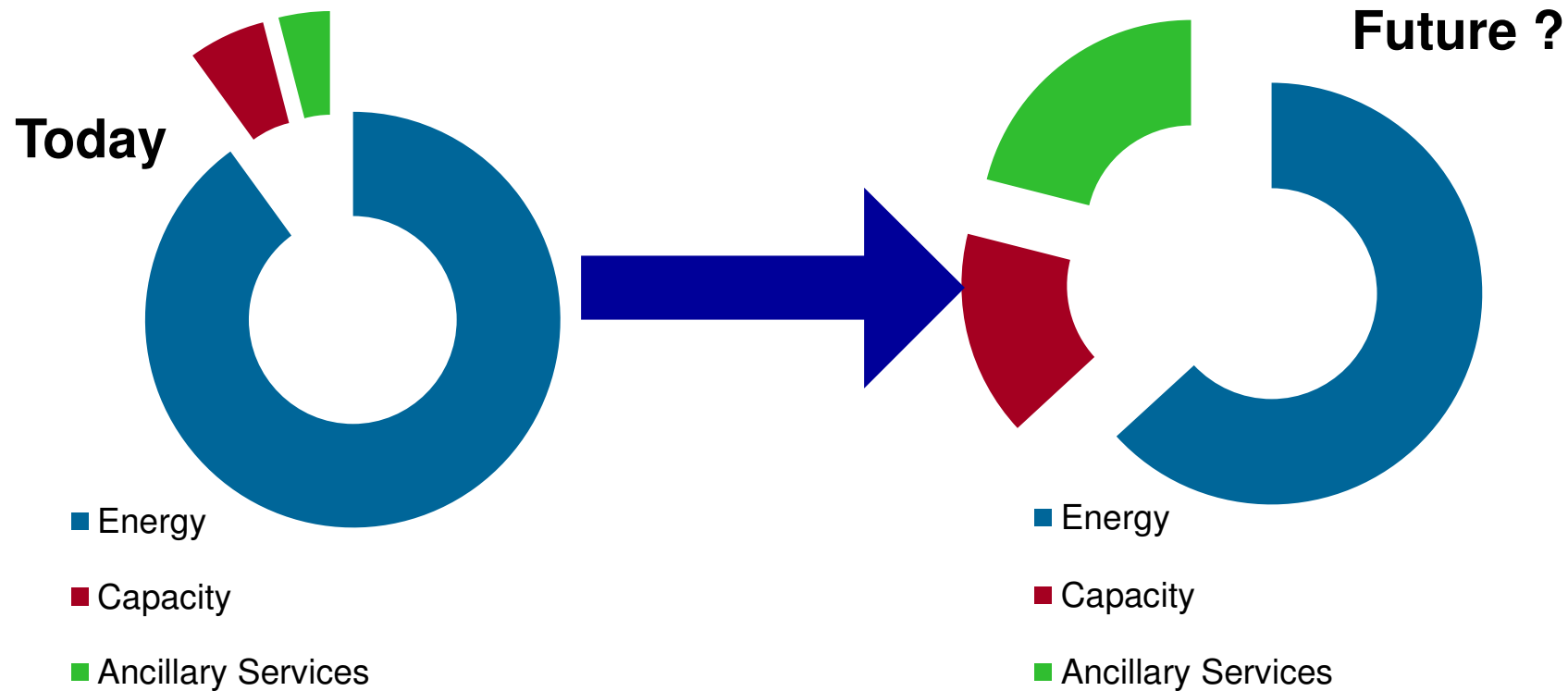


Voltage Control

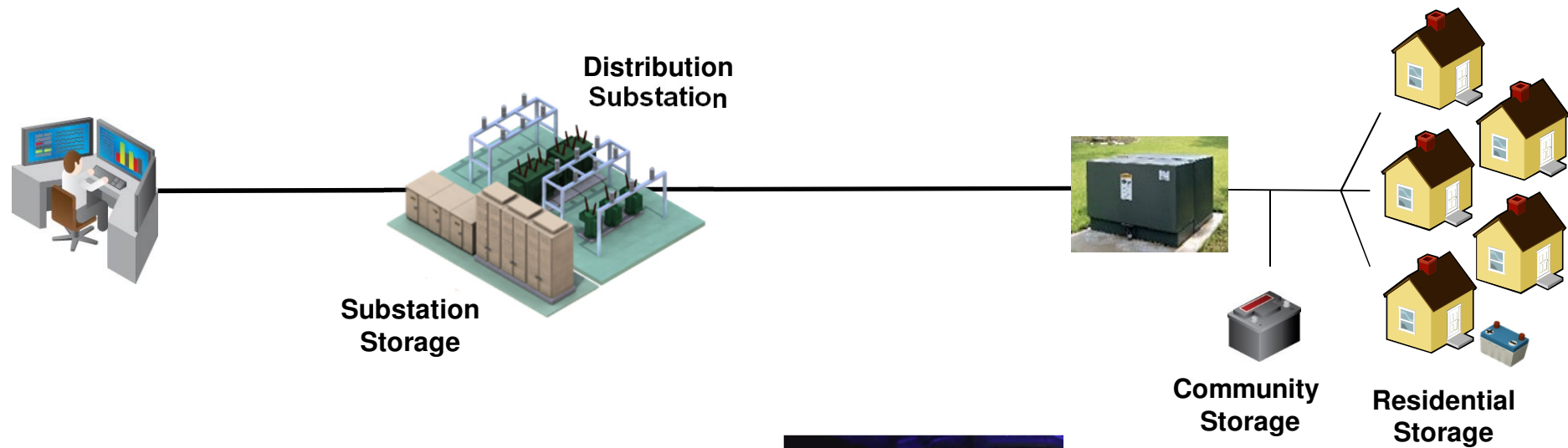


Equipment and Protection Impacts

Capacity and ancillary services become more important



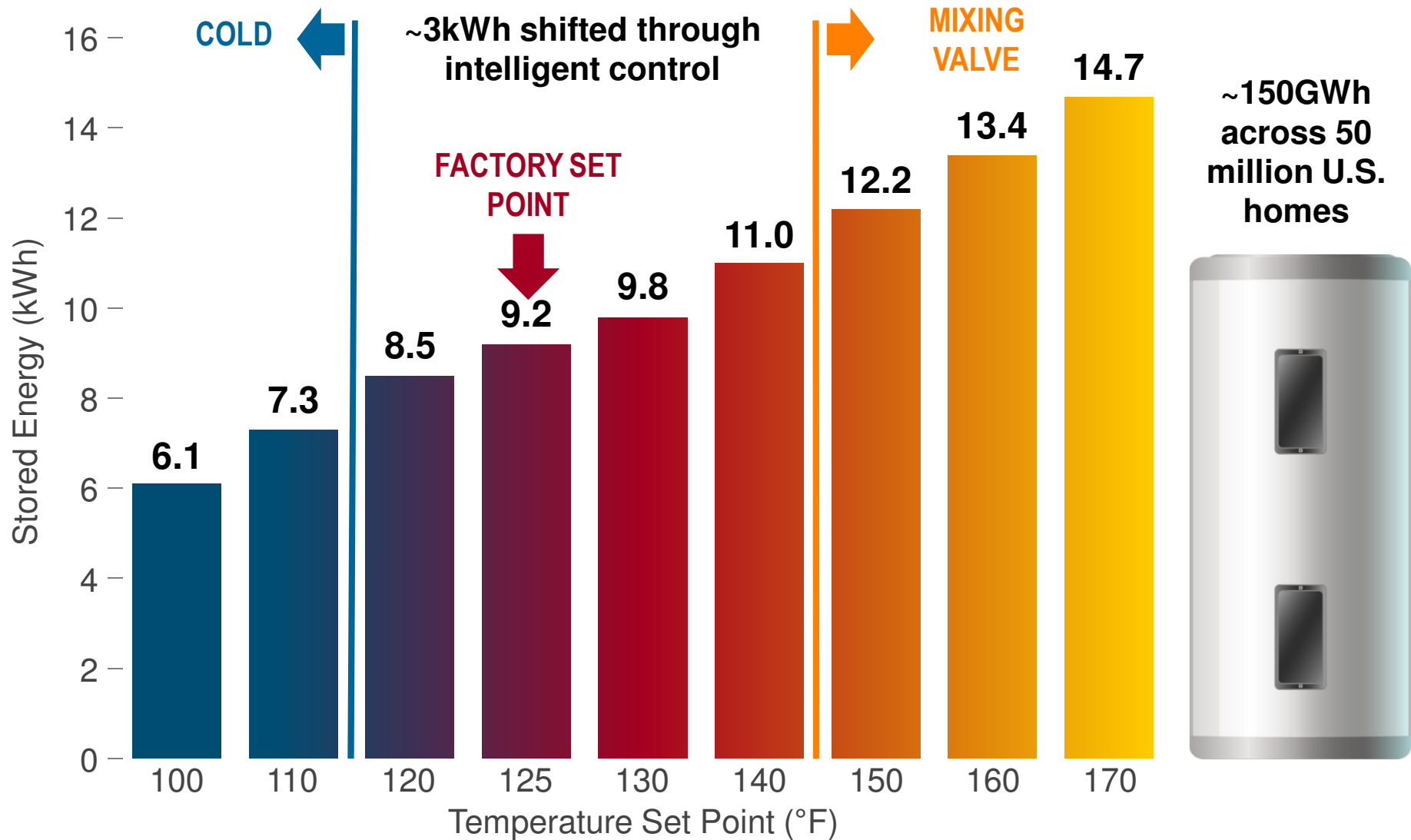
Game Changer – Energy Storage



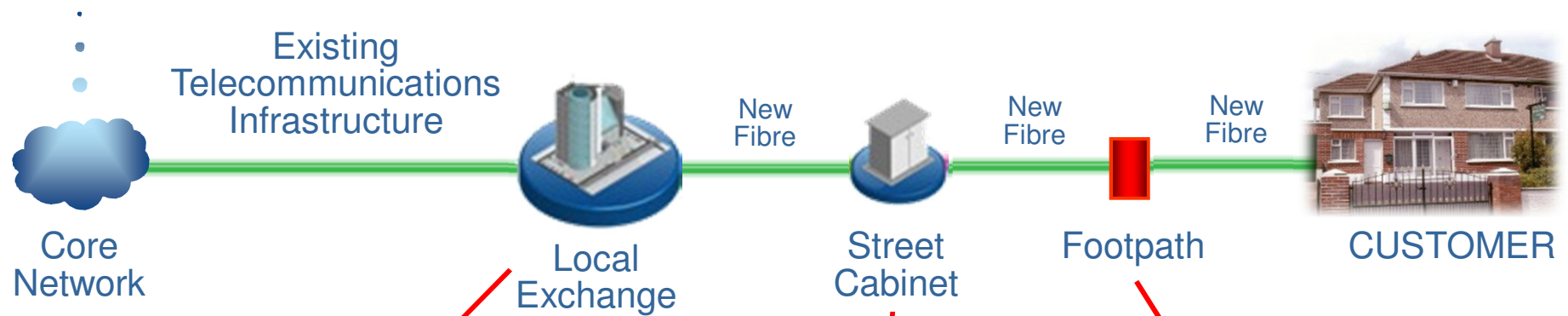
The Winner? ➡



And It's Not Just Batteries



Game Changer – Communications Infrastructure



38kV Station

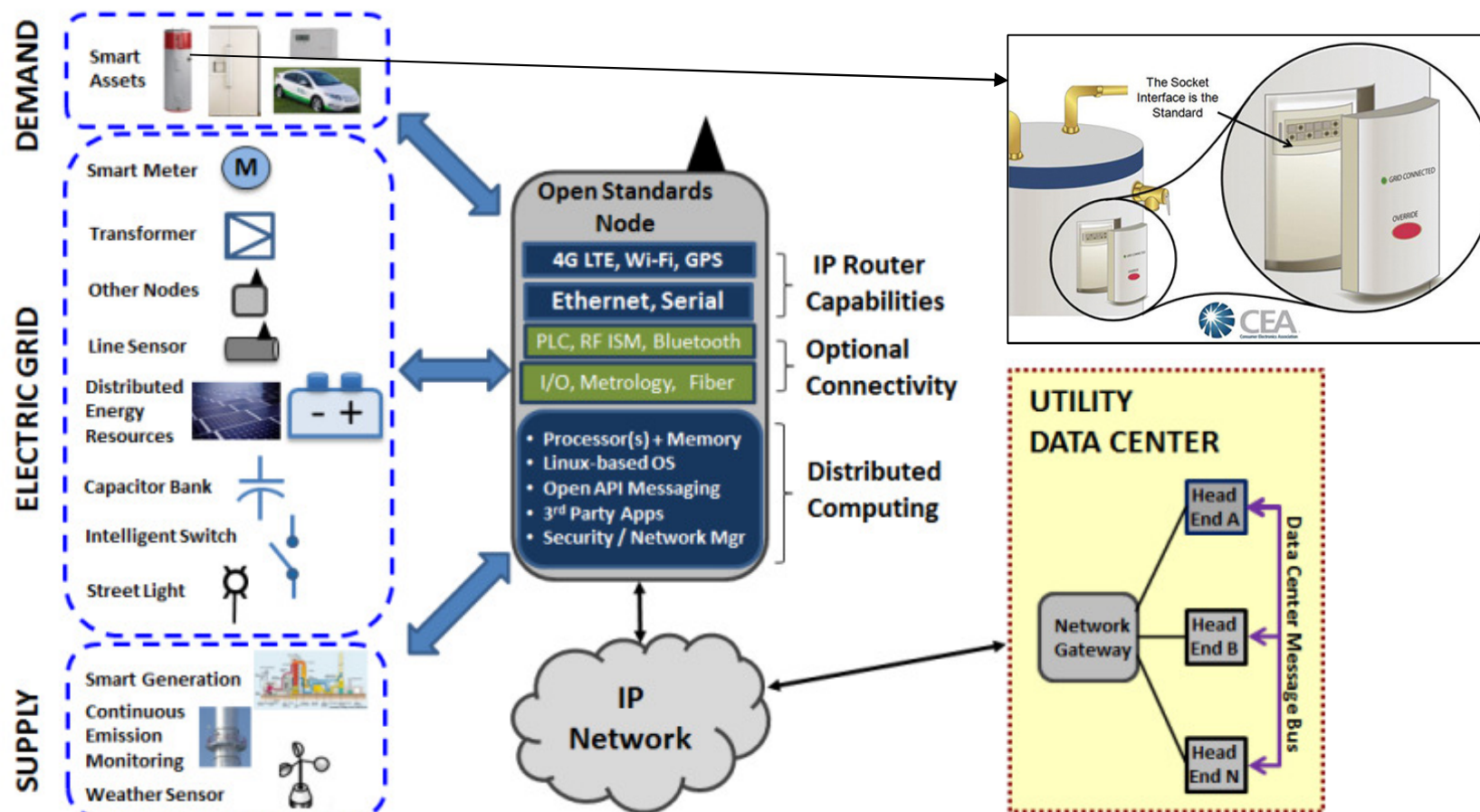


MV/LV Substation

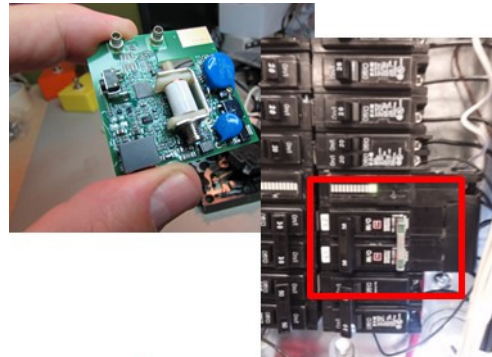


Mini-pillar

Game Changer – Distributed Intelligence



The Ultimate Vision – Open Application Platform



EMCB



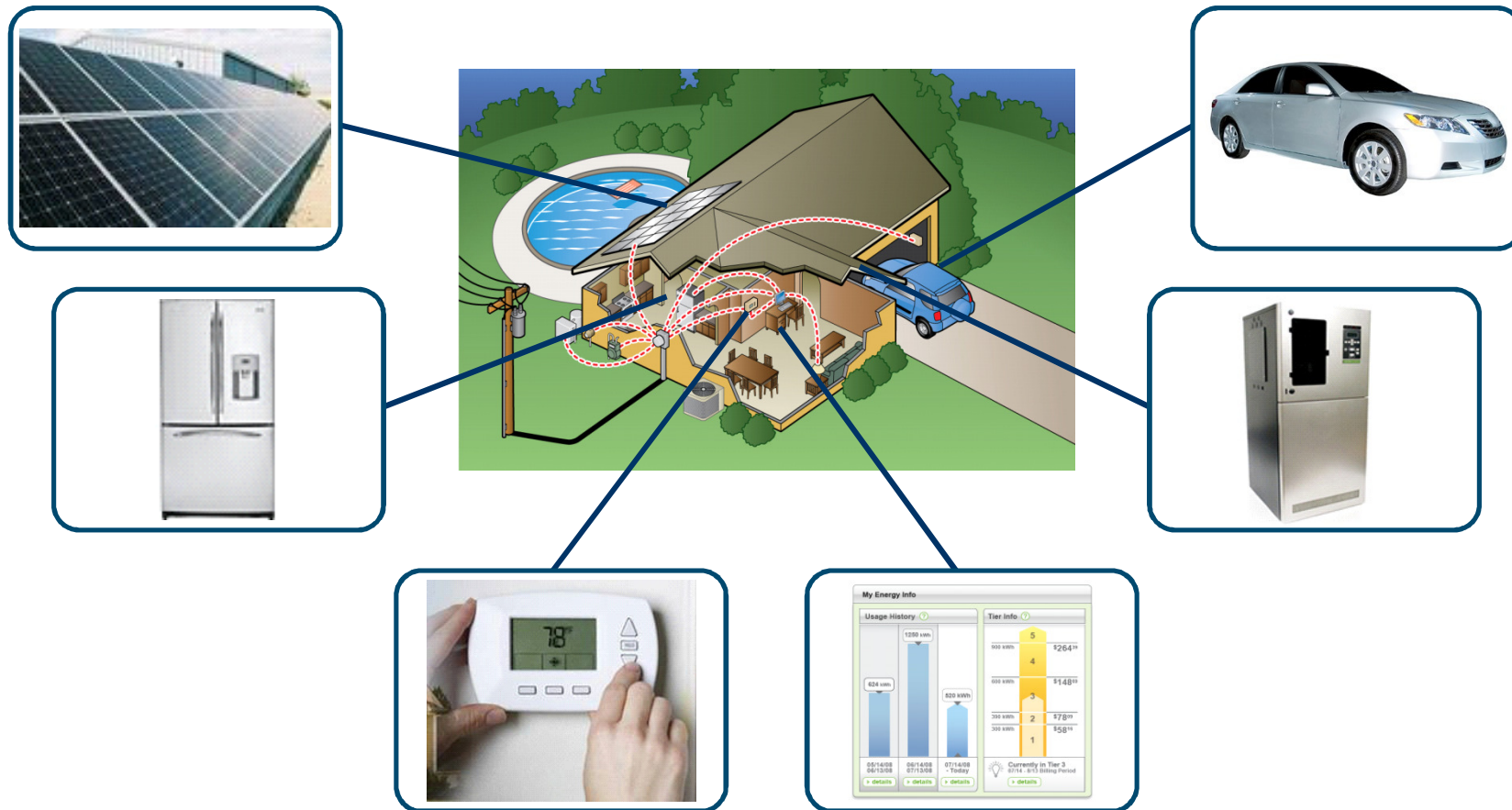
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Transforming Smart Grid Devices Into Open
Application Platforms

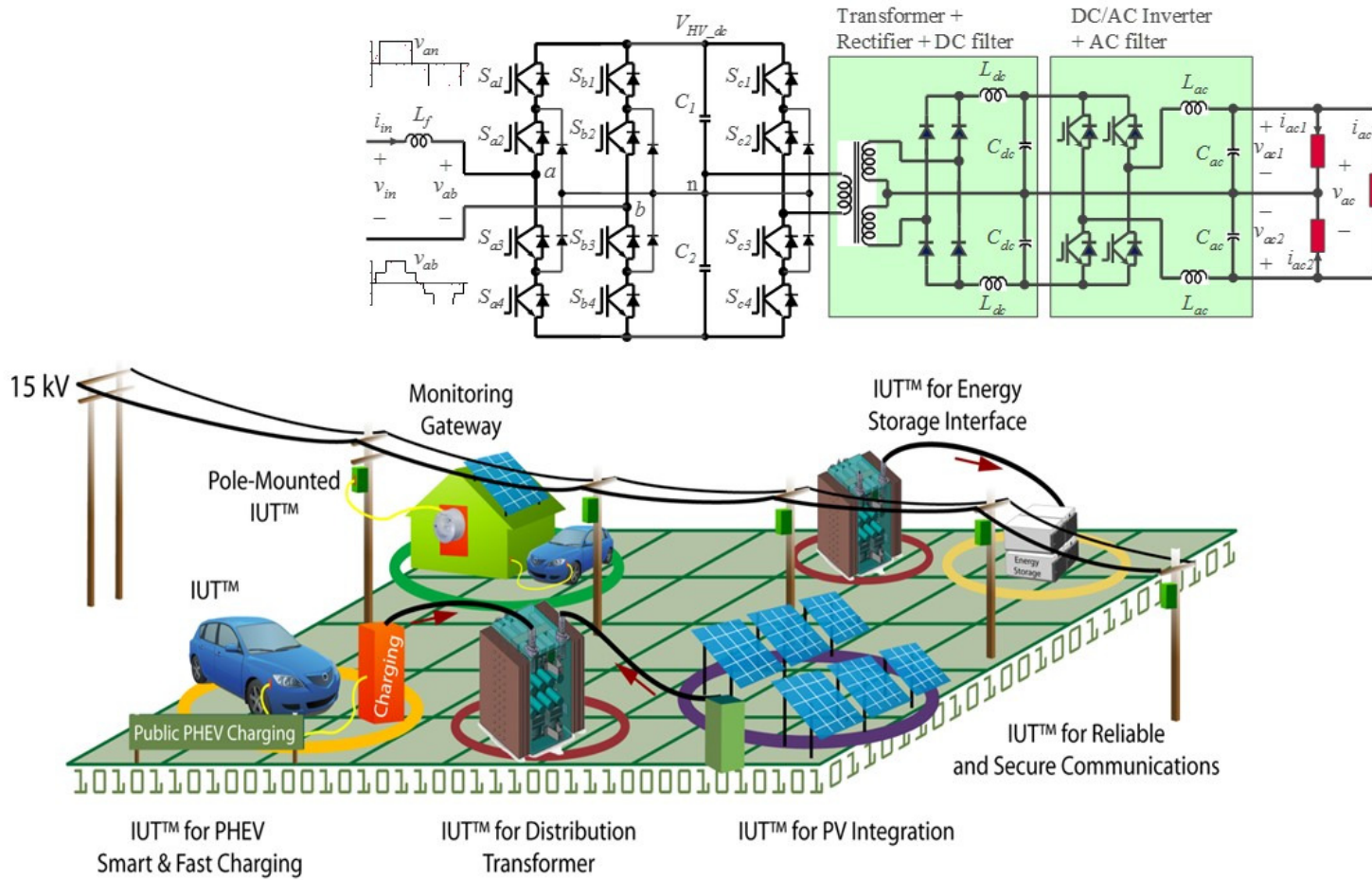
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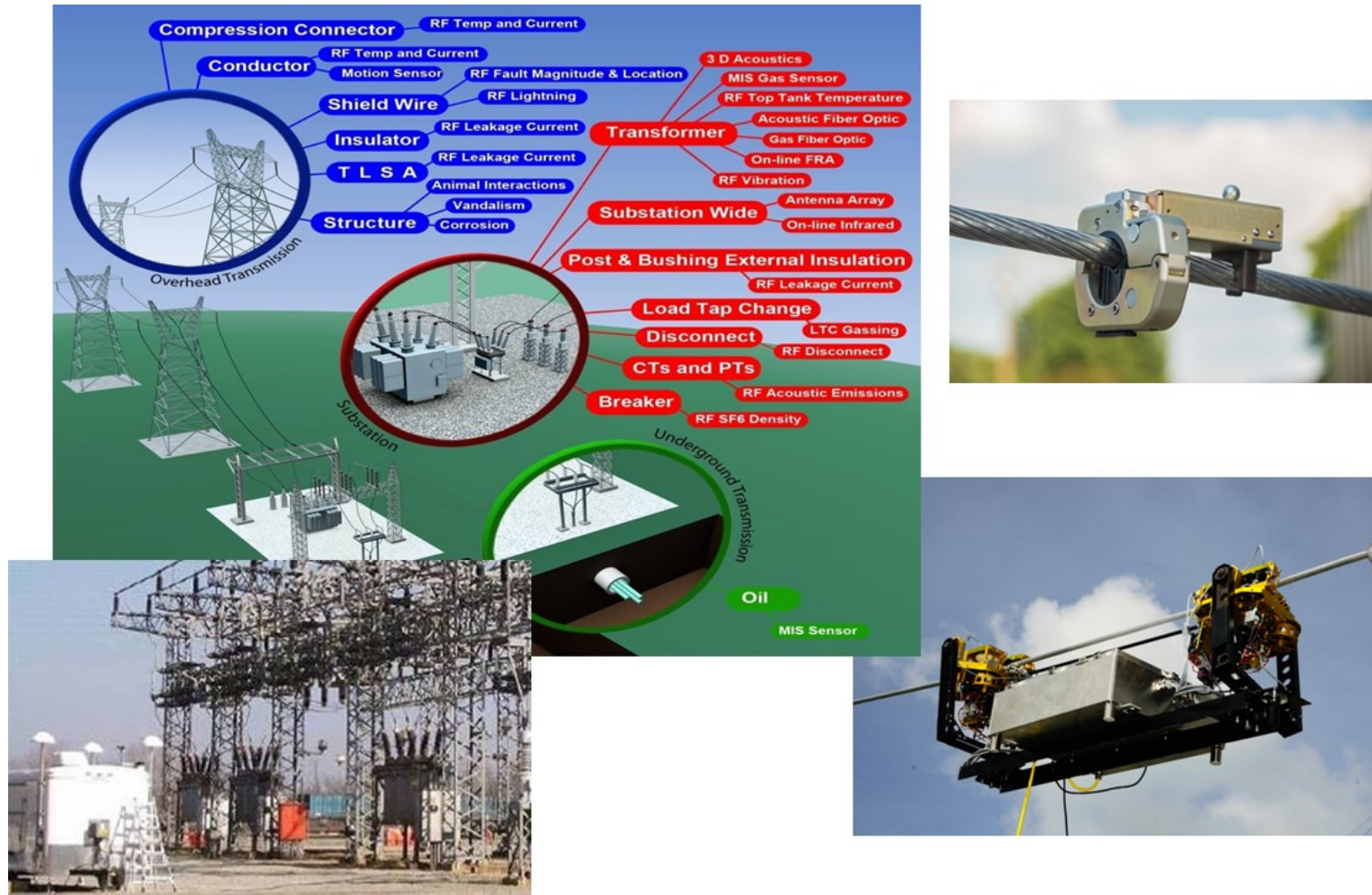
Game Changer – Integrating the Customer



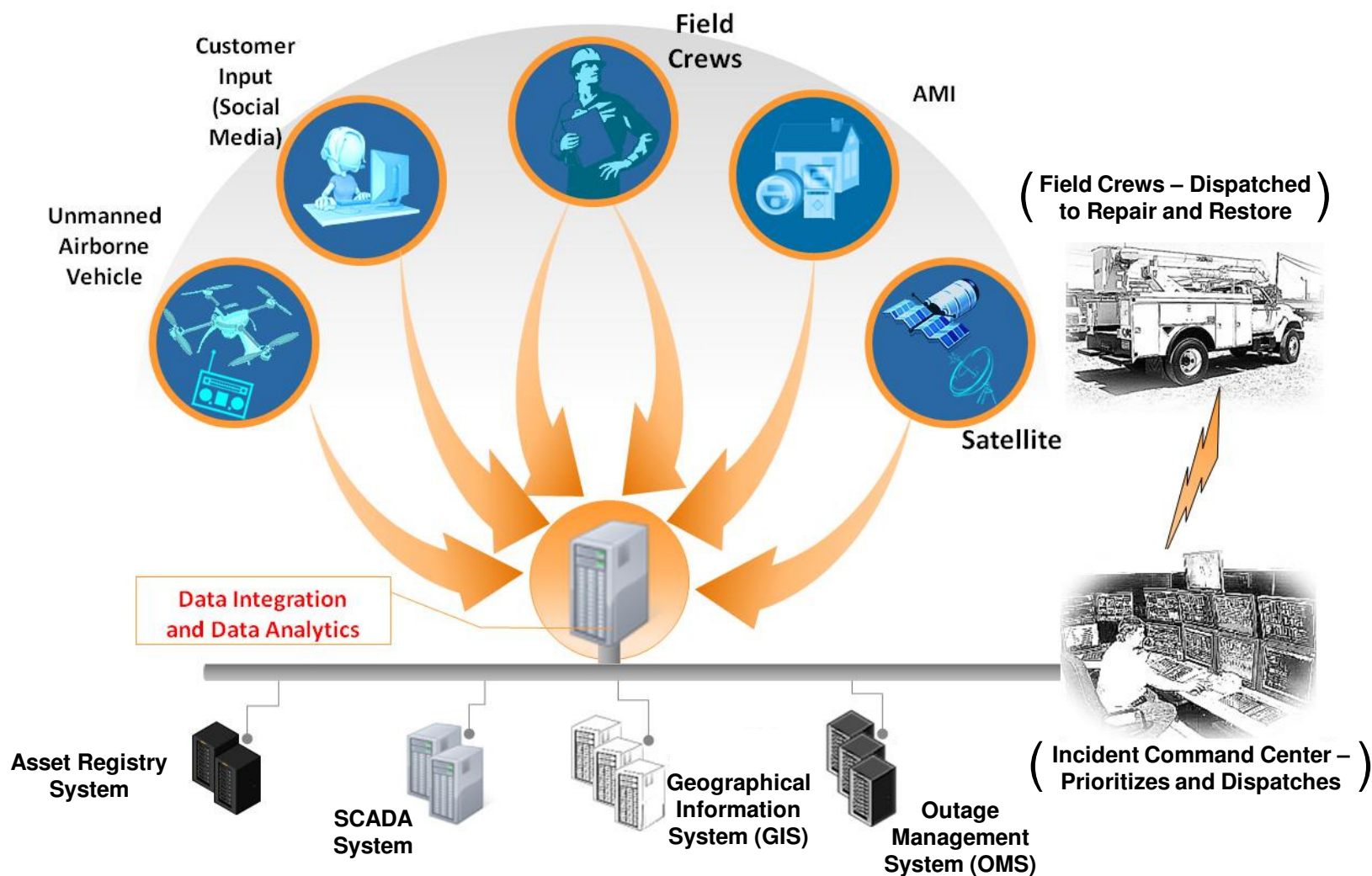
Game Changer – Power Electronics Everywhere!



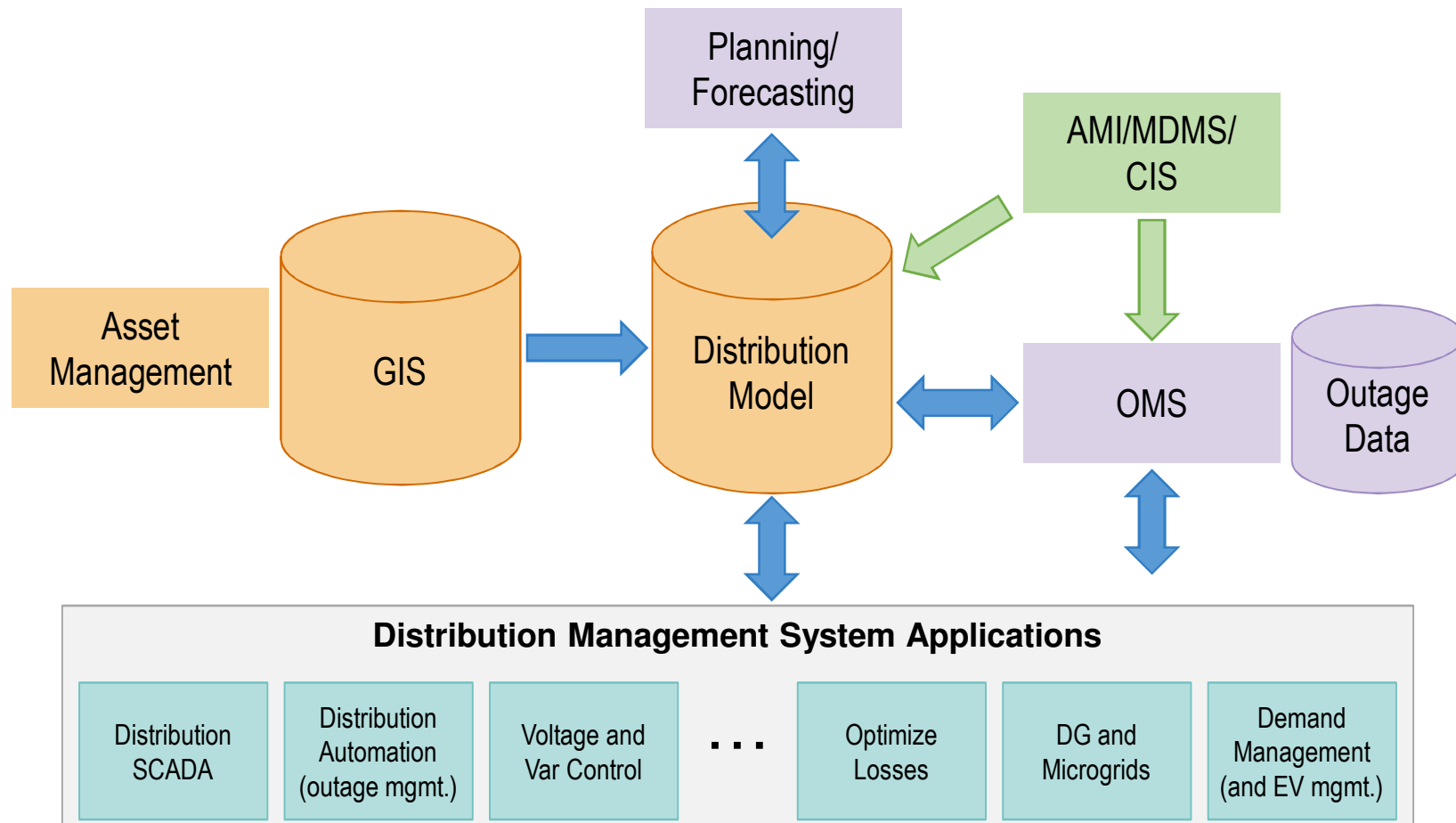
Game Changer – Sensors and Data



Data Integration and Analytics

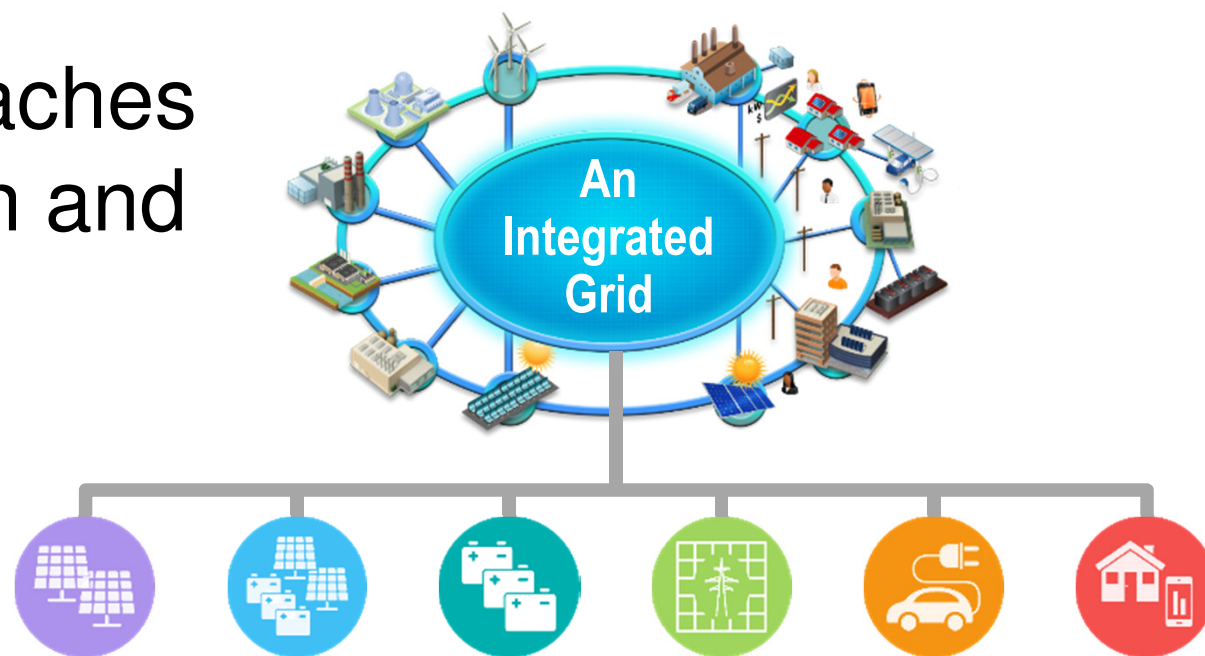


Game Changer – Model Based Management



Challenges – Making it happen

- Research Collaboration and Coordination
- Cross-Cutting Approaches
- Standards
- New approaches to education and training



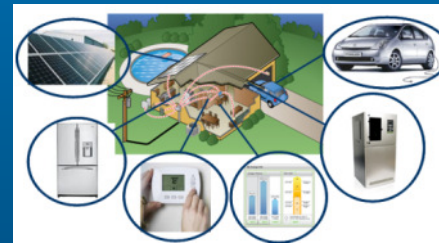
Critical Research Areas for the Integrated Grid

Architecture for the Integrated Grid



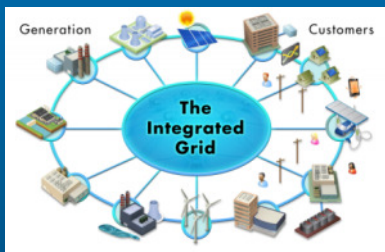
- Information and Communication Infrastructure
- Enterprise Interoperability
- Distributed Controls
- Open Application Platforms
- Cyber Security

Integrating the Customer



- Energy Efficiency
- Voltage Response
- Demand Response
- Local Generation and Storage (EV)
- Resiliency
- Customer Services
- Customer Model

Integrated Planning and Operations



- Integrated Models
- Advanced Simulation
- Real Time Systems
- Distributed Controls and Demand Response
- Risk-Based
- Forecasting and Analytics
- Visualization

Advanced Asset Management



- Sensors and Communications
- Advanced Analytics
- Maintenance and Diagnostics
- Reliability and Resiliency
- Visualization and Decision Support

Industry Developments – North America



Thank You!

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AND DISTRIBUTED ENERGY RESOURCES



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