The Drive Toward Standards-Based Transactive Energy (TE) Solutions

Welcome to the New Energy era of Participative Load

IEEE P825 Workgroup Overview June 23rd 2017

The world's largest professional association

Advancing Technology for Humanity

Global Reach

426,000+ Members

160+ Countries

1,600+ Annual Conferences

Technical Breadth

39 Technical Societies
6 Technical Councils

3,500,000 Technical Documents

180+ Top-cited Periodicals

- Aerospace and Electronic Systems
- Antennas and Propagation
- Biometrics Council
- Broadcast Technology
- Circuits and Systems
- Communications
- Components, Packaging, and Manufacturing Technology
- Computational Intelligence
- Computer
- Consumer Electronics
- Control Systems
- Council on Electronic Design Automation
- Council on Superconductivity
- Dielectrics and Electrical Insulation
- Education
- Electron Devices
- Electromagnetic Compatibility
- Engineering in Medicine and Biology
- Geoscience and Remote Sensing
- Industrial Electronics
- Industry Applications
- Information Theory
- Instrumentation and Measurement
- Intelligent Transportation Systems
- Magnetics
- Microwave Theory and Techniques
- Nanotechnology Council
- Nuclear and Plasma Sciences
- Oceanic Engineering
- Photonics
- Power Electronics
- Power & Energy
- Product Safety Engineering
- Professional Communications
- Reliability
- Robotics and Automation
- Sensors Council
- Signal Processing
- Social Implications of Technology
- Solid-State Circuits
- Systems, Man, and Cybernetics
- Systems Council
- Technology and Engineering Management
- Ultrasonics, Ferroelectrics, and Frequency Control
- Vehicular Technology

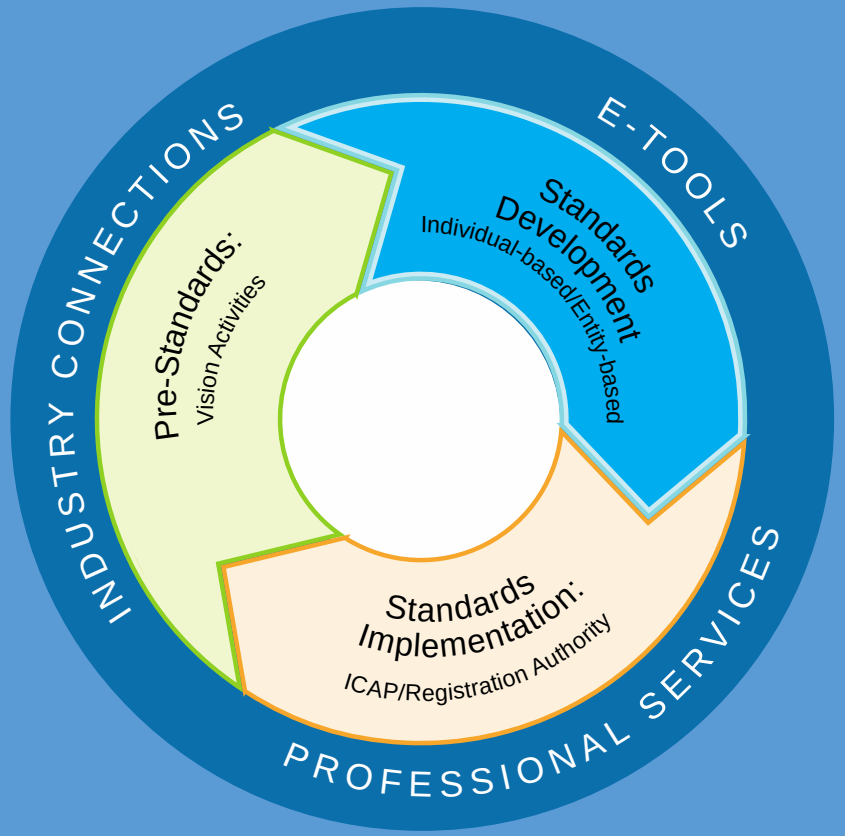
Our P825 Initiative cuts across many IEEE society domains

Complete Business Lifecycle

IEEE 1547

IEEE 2030

Our P825 Initiative is a Pre-Standards Visioning activity –
With the goal of capturing ideas, building context, and publishing a Guide and for industry development of commercially viable Transactive Energy platforms and methods that build upon foundational standards that are further through the development lifecycle.



Apps Apps

2030

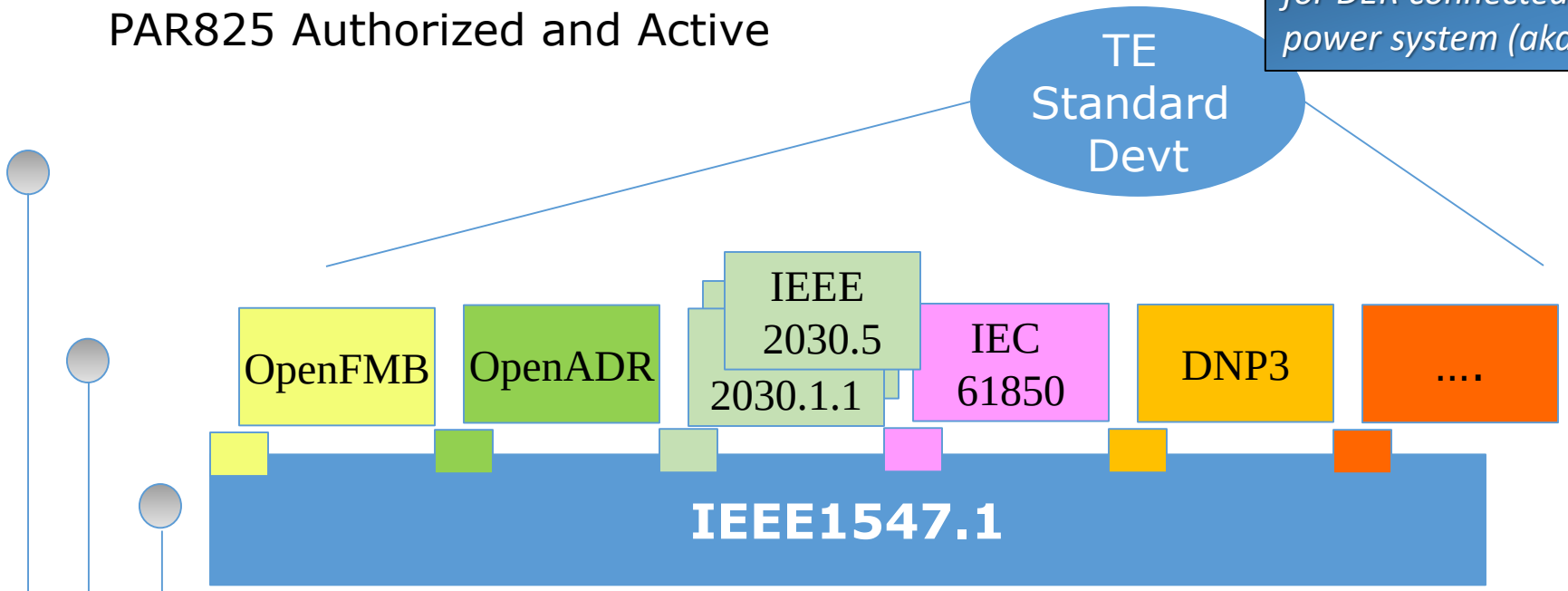
1547

IEEE-SA provides industry a framework of solutions to ensure rapid introduction of new technologies to market

Potential TE *Certification Program Basis*

There are several developing industry standards that establish interoperability for DER connected to the area electric power system (aka "Grid").

Status: Mar 2017
PAR825 Authorized and Active

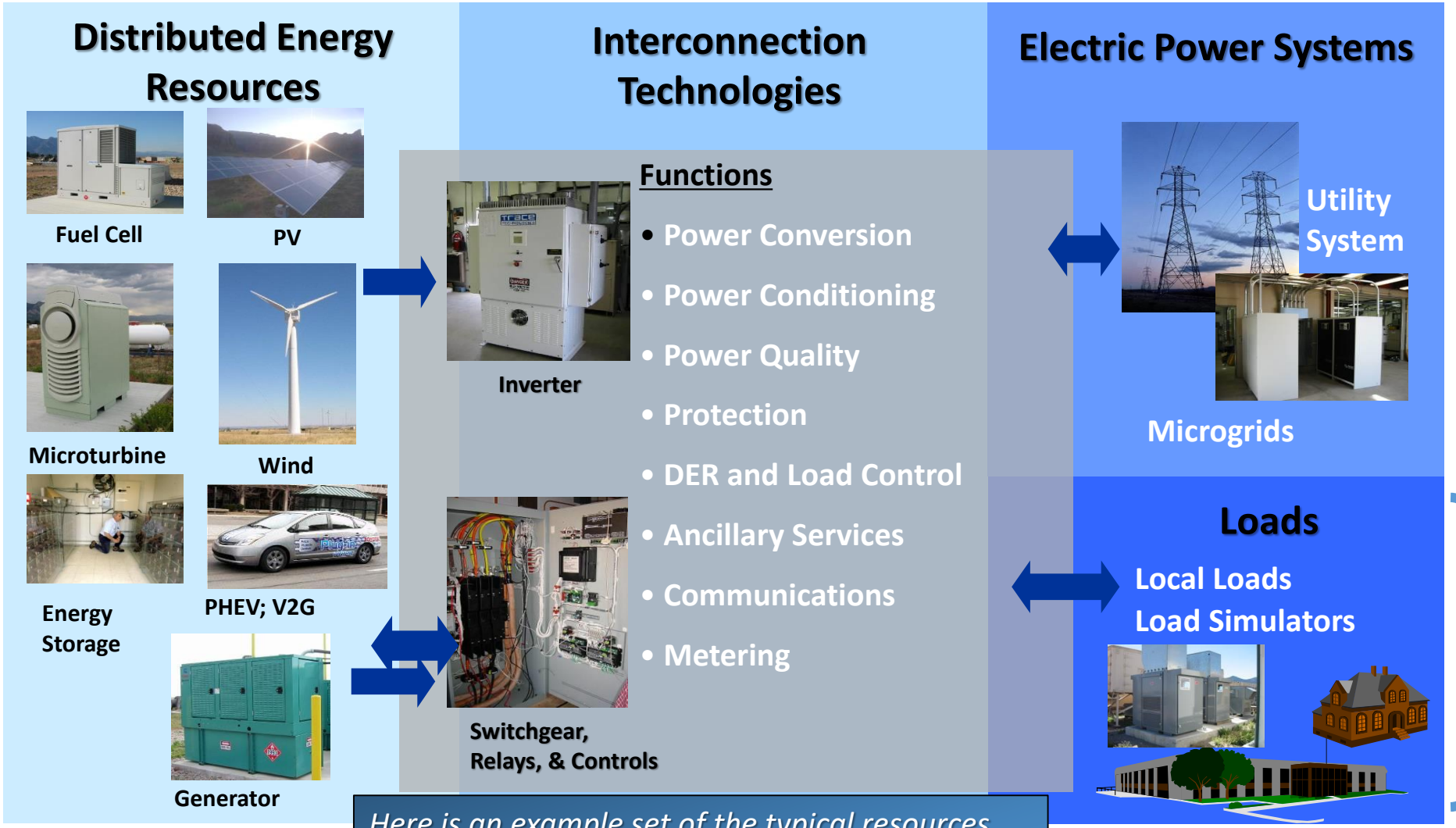


DER-AEPS Interconnection Layer (see companion 1547 slides)

Connection/Communication/Control Protocol Layer

Program/Application Layer

Distributed Energy Resources Interconnection



Evolution

- **IoT** .. enabled
- **Wireless**.. powered
- **Energy** .. stored
- **SiC, GaN**.. equipped

Here is an example set of the typical resources and the interconnection functions that govern their connection and use with the area EPS. Fast emerging technologies that are becoming

Evolution

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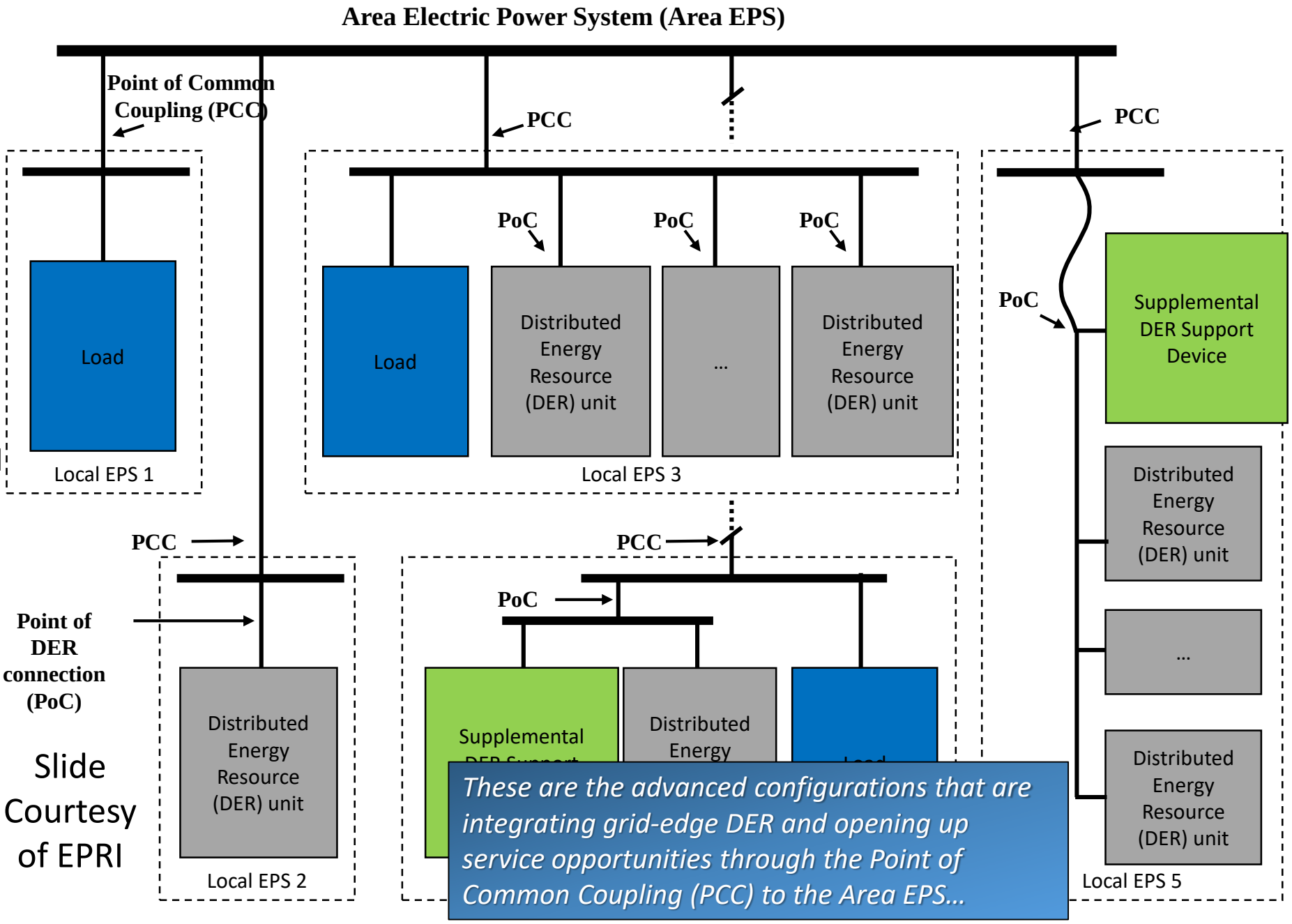
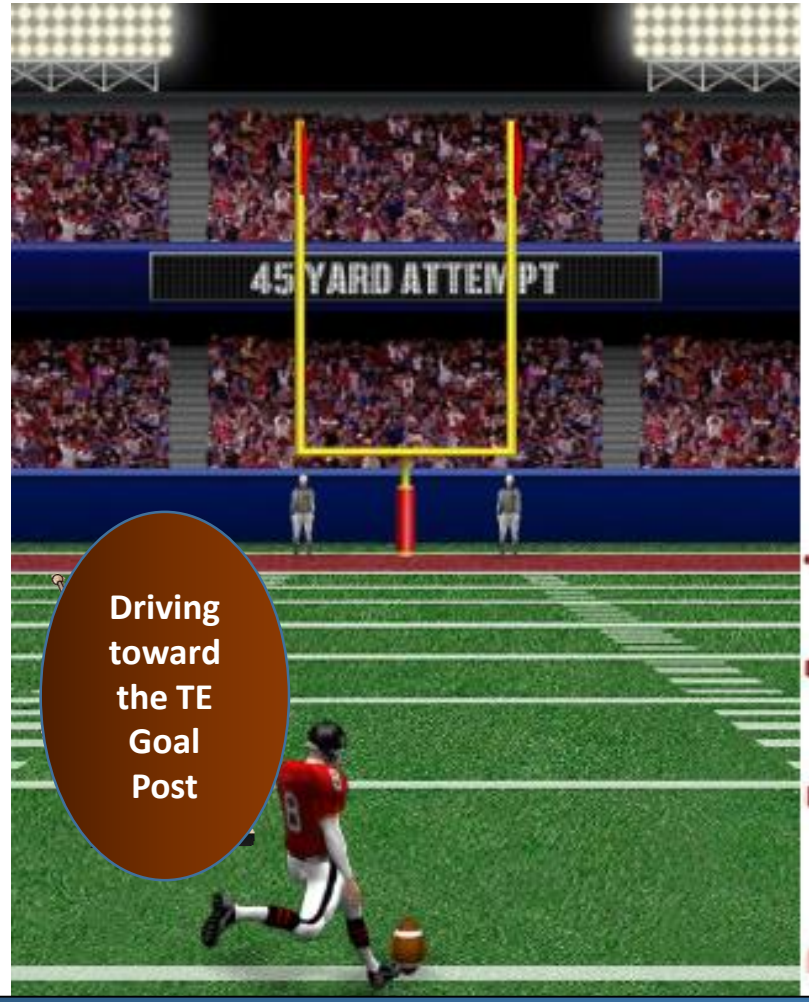


Slide Courtesy of EPRI

These are the advanced configurations that are integrating grid-edge DER and opening up service opportunities through the Point of Common Coupling (PCC) to the Area EPS…

The Playing Field – The Drive Toward TE



VERY COMPLEX INTERSECTION OF

- TECHNOLOGY CAPABILITY
- REGULATORY ALLOWANCE
- FINANCIAL/BUSINESS MODELS
- MARKET EFFICIENCY

FULL TRANSACTIVE (PREDICTIVE)

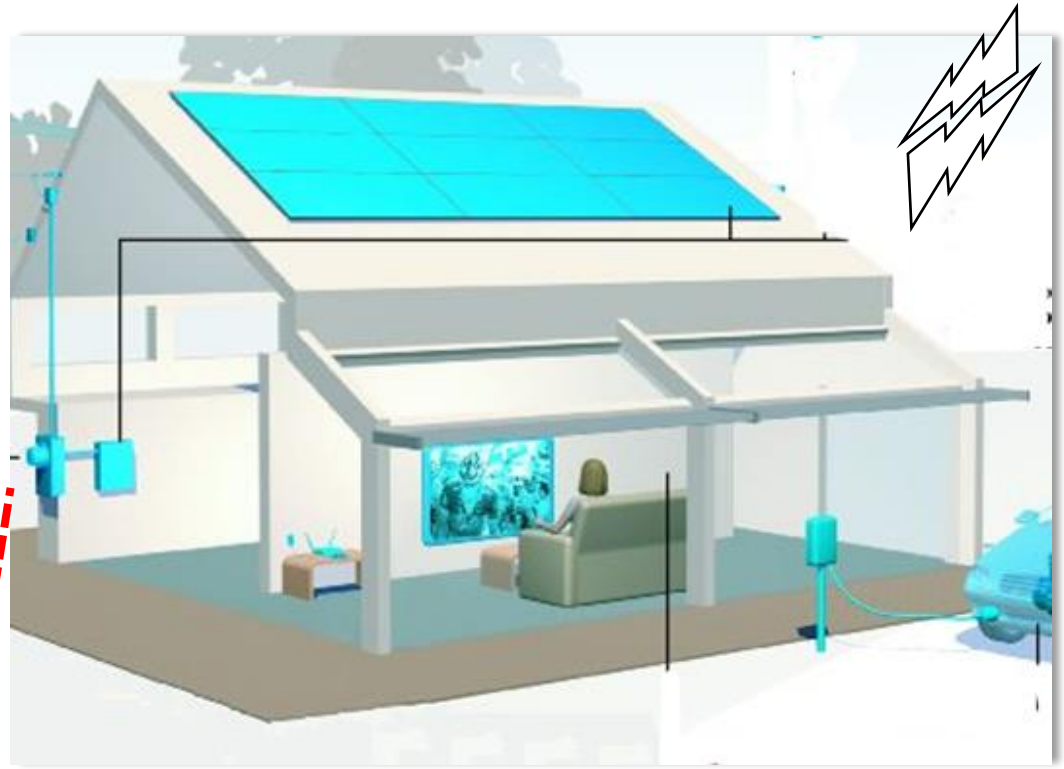
PARTIAL TRANSACTIVE (PROACTIVE)

NET ENERGY METERING (PERMISSIVE)

RESPONSIVE LOAD (REACTIVE)

A metaphor that can serve for our march downfield toward fully Transactive Energy methods … American Football. We are driving toward the goal posts of predictive, efficient, and automated energy transactions that enable a broadly decentralized electric power distribution model..

Advancing Downfield



RESPONSIVE LOAD (REACTIVE)

NET ENERGY METERING (PERMISSIVE)

TRANSACTIVE ENERGY (PROACTIVE)

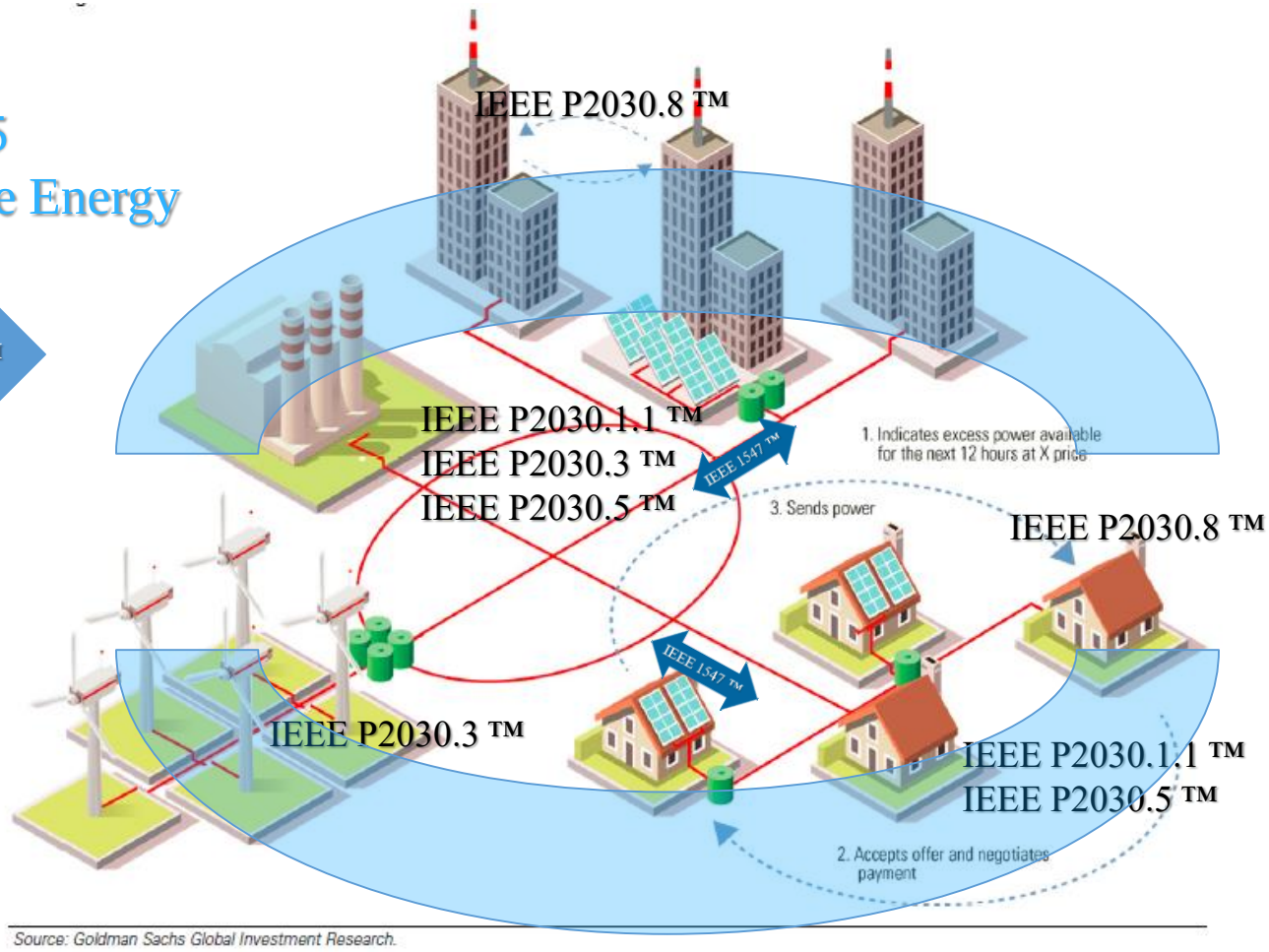
The End Zone: Transactive Energy Microgrid Network

To get there we need an Intersection of Standards

- Certified Interconnection
- Networking and Communications
- Interoperability Use Profiles
- Cyber Security/Trusted Actors
- Distribution and Load Side Automation

IEEE P825
Transactive Energy
built on…

IEEE 1547 ™



Transactive Energy can become the "Operating System" for DER serving local load with Distributed Generation or connected through Microgrid configurations

The End Zone: Transactive Energy EV Grid Services

Wireless Charging SEP 2.0 5G cell

Smart Inverter OpenADR GPS / GIS

IoT Blockchain IPv6

A Though Experiment: How could a swarm of Autonomous Electric Vehicles be called to a common aggregation point and compensated for delivering grid services as part of a disaster recovery operation? This begins to reveal the extent of cross-standards integration and interoperability that would be required for this complex Transactive Energy use profile. Futuristic? Maybe, but coming fast!

Thank You!

IEEE Standards Association
http://standards.ieee.org/

w.ash@ieee.org

Bill leads all of the Smart Grid related standards development initiatives

paul.heitmann.us@ieee.org

Paul supports the IEEE1547 CASCADE and P825 Interoperability programs

r.subramaniam@ieee.org

Ravi leads the Conformity Assessment certification process for applicable IEEE standards