



# **Smart Grid Demonstrations show energy efficiency potential**

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# Electric Power Research Institute

Collaboration....Technical Expertise....Thought Leader



- Not for profit, collaborative electricity research organization with more than 450 participants in over 40 countries
- International funding accounts for nearly 20% of total program
- U.S. utilities placed approximately 80% of their R&D investment with EPRI in 2012.
- Independent electricity research in:
  - Generation
  - Environment
  - Power Delivery & Energy Utilization
  - Nuclear
- 1600+ R&D projects annually, ~\$380M R&D funding and 10 to 1 average funding leverage

# EPRI Smart Grid Demonstrations

- Deploying the Virtual Power Plant
- Demonstrate Integration and Interoperability
- Leverage information and Communication Technologies
- Integration of Multiple Types of Distributed Energy Resources (DER):

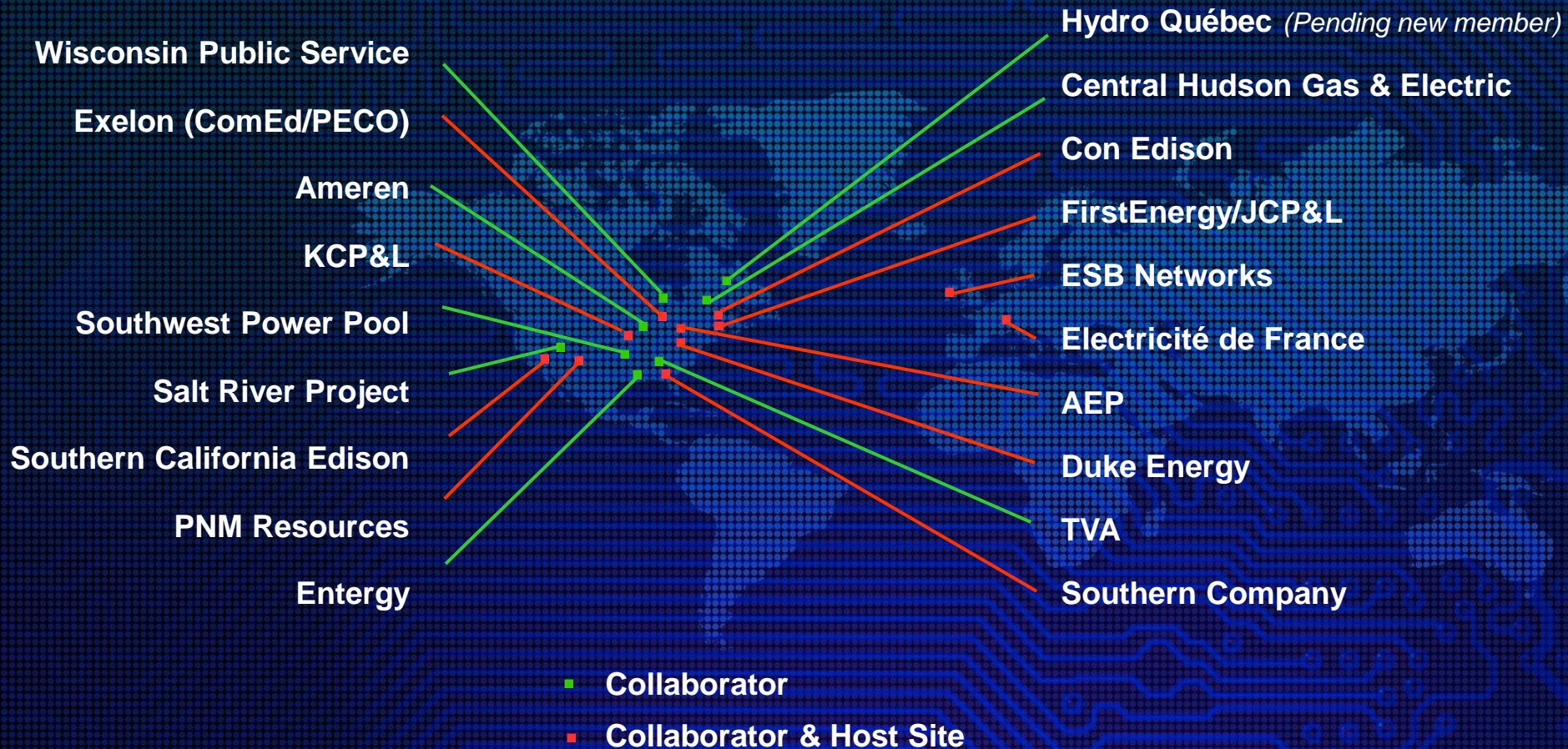
- ✱ Distributed Generation
- ✱ Renewable Generation
- ✱ Storage
- ✱ Demand Response

✱ Multiple Levels of Integration – Interoperability





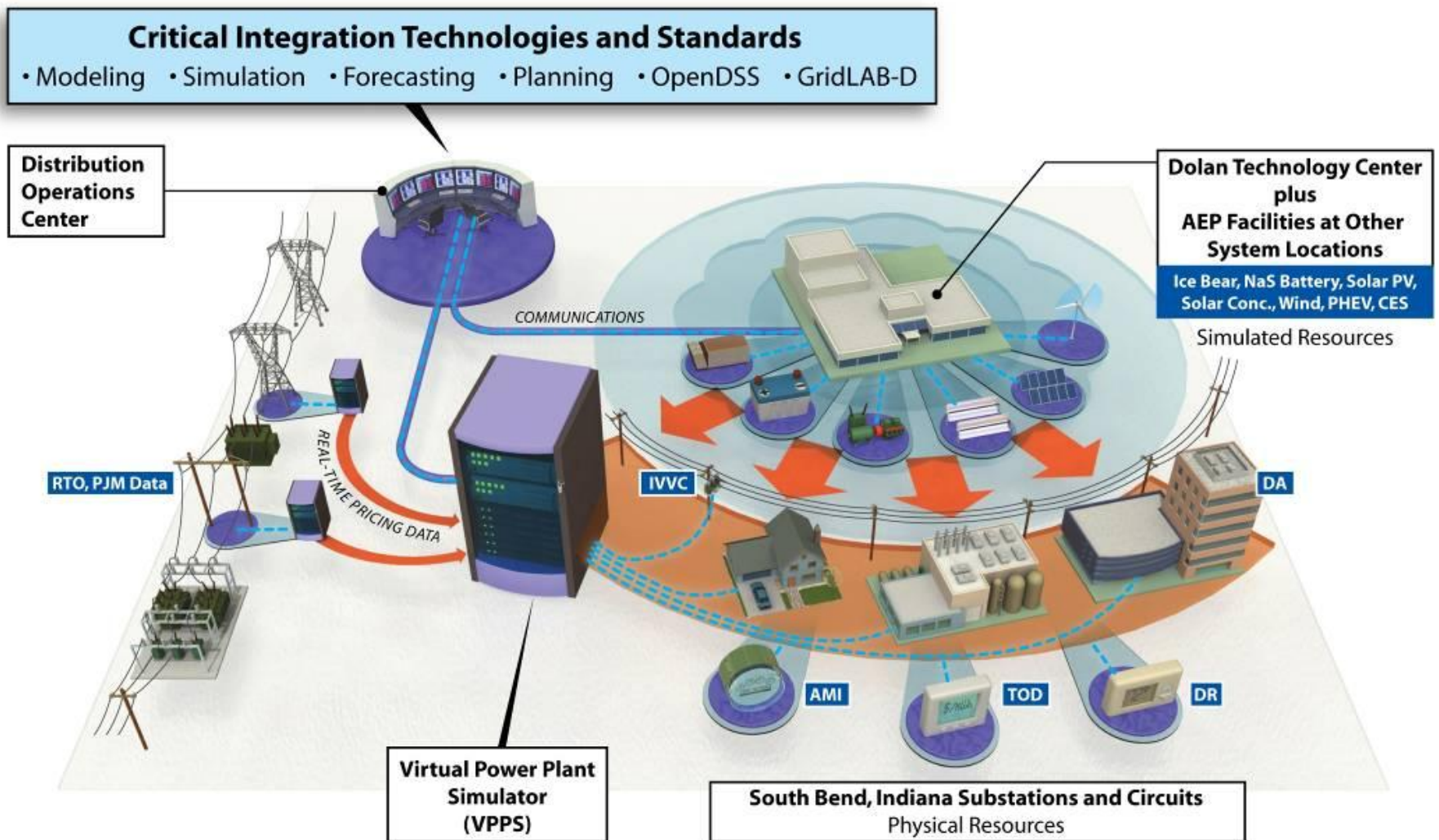
# Smart Grid Demonstration - 18 Collaborators





# American Electric Power Demonstration Project

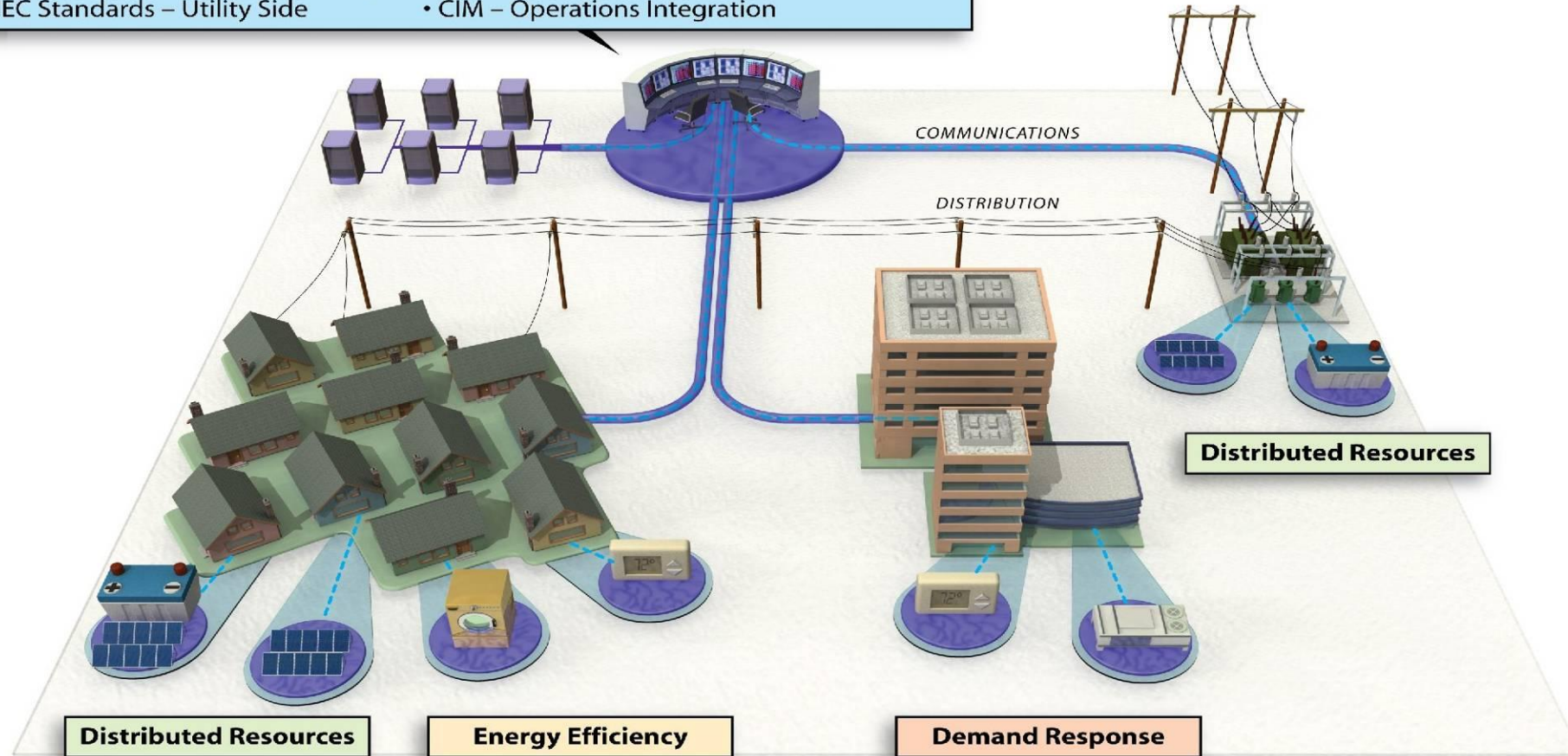
## “Virtual Power Plant Simulator”



## High-Penetration PV thru Grid Automation and Demand Response

### Critical Integration Technologies and Standards

- Intelligrid-Based Use-Case Analysis
- Zigbee/Homeplug, BACNET – Customer Side
- IEC Standards – Utility Side
- CIM – Operations Integration





# A Case Study on Volt-VAR Control Integrated with Wind Turbine Inverter Control



*A constant voltage mode of operation can be delivered through variation of VAR output, independent of MW generation.*

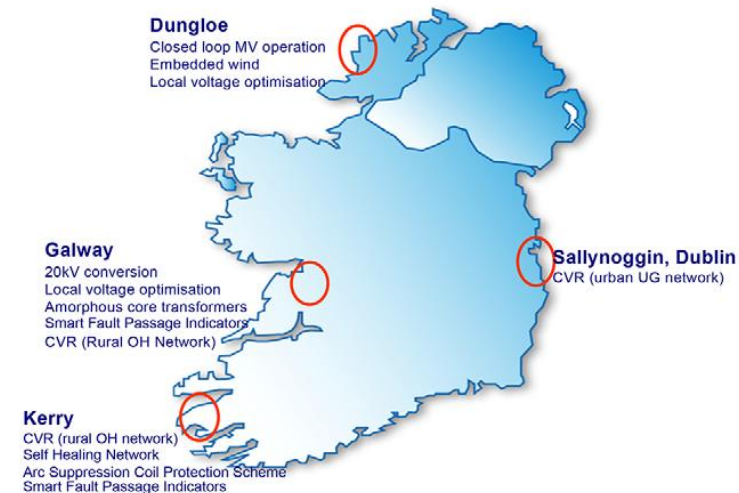


**The reactive power capabilities of modern wind turbines can be used for a range of objectives, such as loss reduction, local voltage control and reactive power export.**

# A Case Study on Smart Green Circuits



*An arc suppression coil protection system has helped reduce costs; fault finding time has been reduced from 9 hours to 1.5 hours, and measured continuity of performance improved by 100%.*



**A “self-healing” circuit has operated successfully in over 12 separate incidents, with faulted sections isolated and supply recovered to remaining customers within seconds.**



# Demonstration Cross Collaboration Opportunities Based on Highest Priority Smart Grid Issues

Primary Integrated Technologies & Applications		Smart Grid Demonstration Members																		
		Host Site Collaborators											Collaborators							
		AEP	Con Ed	Duke	EDF	ESB	Exelon	FE	KCP&L	PNM	SCE	Southern	Ameron	CHG&E	Entergy	SPP	SRP	TVA	WPS	
Distributed Energy Resources	Demand Response Technologies																			
	Electric Vehicles																			
	Thermal Energy Storage																			
	Electric Storage <= 100 kWh (Utility Local Storage, Customer Storage,...)																			
	Electric Storage > 100 kWh (Typically at substations or near renewables .)																			
	Solar Photovoltaic																			
	Wind Generation																			
	Conservation Voltage Reduction (volt/var management and related)																			
	Distributed Generation (Microturbin, Fuel Cell, Diesel Generator, Biogas,...)																			
Communications and Standards	Customer Domain (SEP, BACnet, HomePlug, WiFi, etc.)																			
	Transmission & Distribution (IEC 61850, 60870, DNP3, IEEE 1547)																			
	Operations Domain (IEC 61968/61970, MultiSpeak, OpenADR,...)																			
	Cyber Security (Authentication, Certificates, Encryption, Intrusion Detection,...)																			
	AMI or AMR																			
	RF Mesh or Tower																			
	Public or Private Internet																			
	Cellular Based (1xRTT, GPRS, EVDO, CDMA, 3G, LTE, 4G,...)																			
	WiMAX (IEEE 802.16) Communications																			
Programs	Price Based (RTP, DA, CPP, PTR, TOU, Block,...)																			
	Incentive Based (DR, DLC, Ancillary Services, Interruptible, Bidding,...)																			
Ops & Planning	Integration with System Operations (RT Visibility of DER, DMS Integration)																			
	Integration with System Planning (Visibility of DER in planning,...)																			
	Modeling and/or Simulation Tools																			

## Cross Collaboration Opportunities

- Areas of Interest
- Similar Project Learnings

# Together...Shaping the Future of Electricity