ELECTRIC POWER RESEARCH INSTITUTE

EPRI Smart Grid R&D Overview

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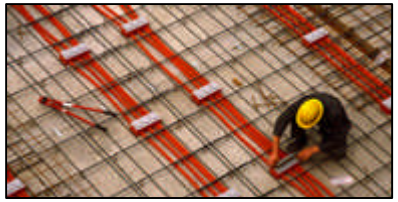
Overview

- EPRI Intelligrid Program: Context
- Smart Grid Demonstration Initiative: Distributed Resource Integration
- Q&A

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
- U.S. utilities placed approximately 72% of their R&D investment with EPRI in 2007.
- Independent electricity research in:
  - Generation
  - Environment
  - Power Delivery & Energy Utilization
  - Nuclear
- 1600+ R&D projects annually, ~$300M R&D funding, more than 400 engineers and scientists

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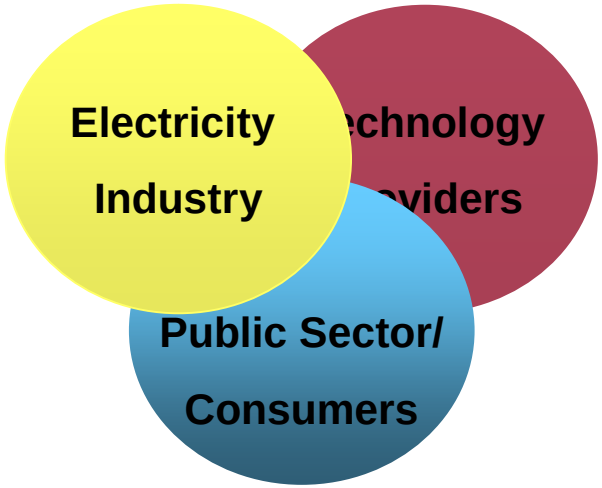
Background - EPRI's IntelliGrid Program

Mission: To accelerate the transformation of the power delivery infrastructure into the intelligent grid needed to support the future needs of society



- Over 50 companies funding the program
- Staff of 10 technical experts
- Conducts collaborative R&D to:
  - Define what a Smart Grid is for individual utilities
  - Understand issues and best practices for deploying Smart Grids
  - Advance the industry towards interoperable systems & components
  - Assess technologies and products through lab and field testing

Smart Grid Characteristics

IntelliGrid℠ | NETL | MODERN GRID STRATEGY

– *Self-Healing* and *Adaptive*	• ***Self-heals***
– *Interactive* with consumers and markets	• ***Motivates and includes the consumer***
– *Optimized* to make best use of resources and equipment	• ***Enables markets***
– *Predictive* rather than reactive, to prevent emergencies	• ***Optimizes assets and operates efficiently***
– *Distributed* across geographical and organizational boundaries	• ***Provides power quality for 21st-century needs***
– *Integrated*, merging monitoring, control, protection, maintenance, EMS, DMS, marketing, and IT	• ***Accommodates all generation and storage options***
– *More Secure* from attack	• ***Resists attack***

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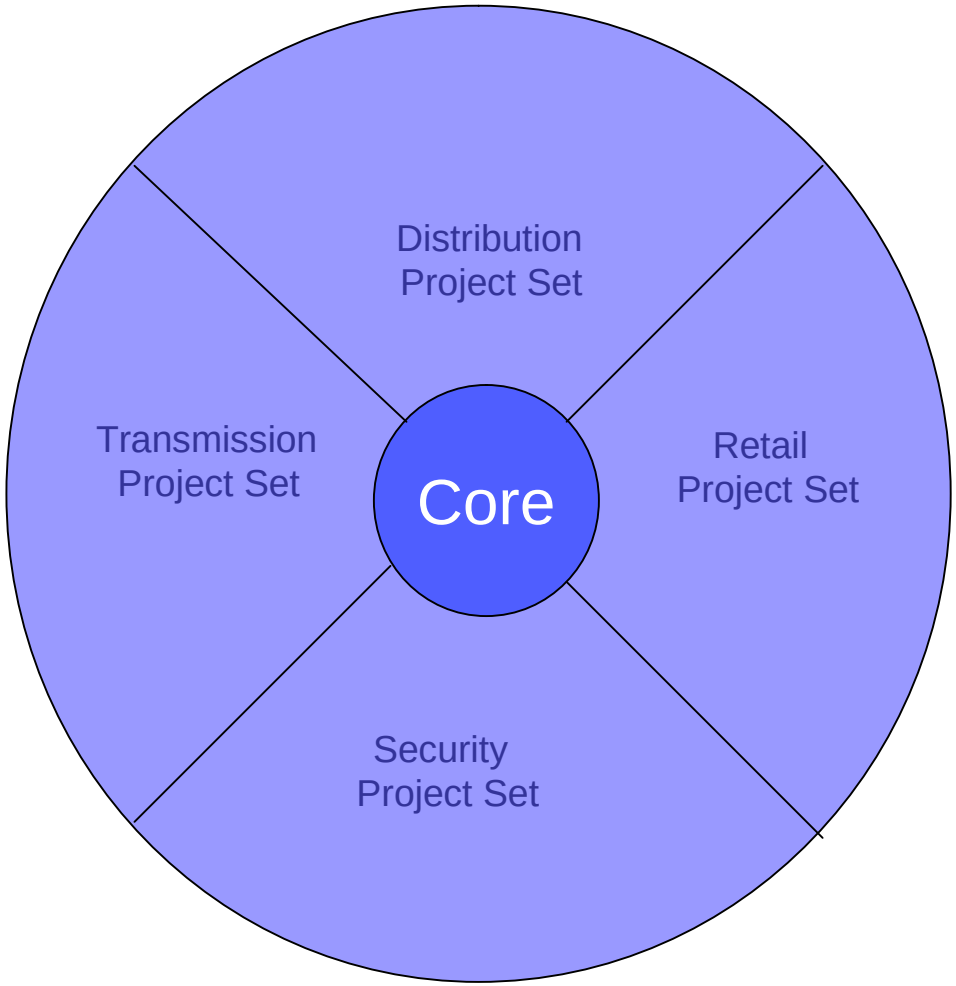
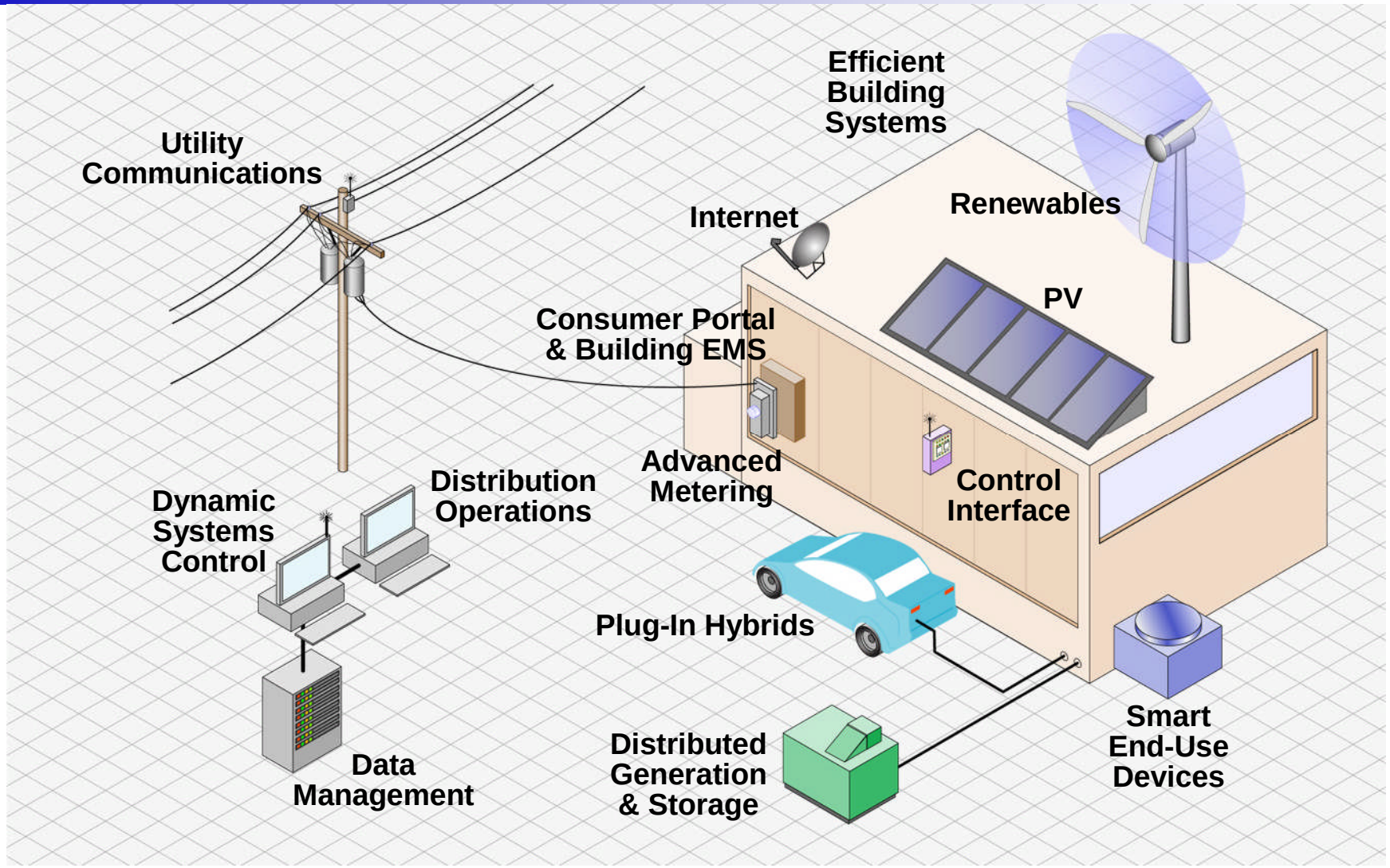
IntelliGrid Program Structure



R&D to Develop the Foundation of Smart Grid

- Smart Grid Requirements gathering methodology
- Standards assessment and contribution
- Information model to facilitate systems integration
- Communication technology assessment
- Security Policy for smart grid applications

Smart Grids can enable Distributed Resource Integration



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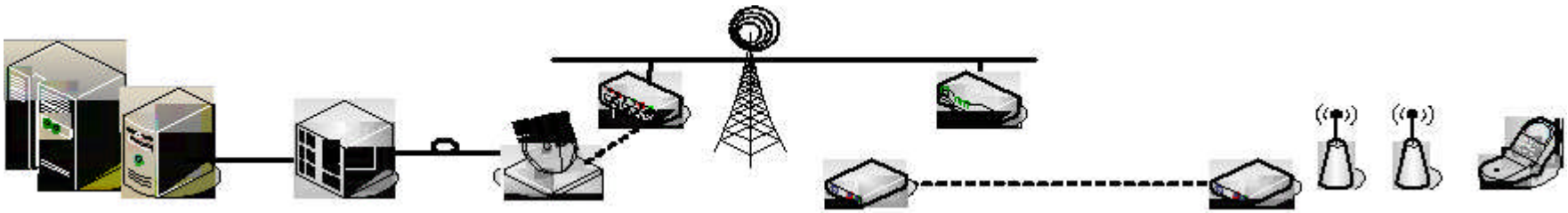
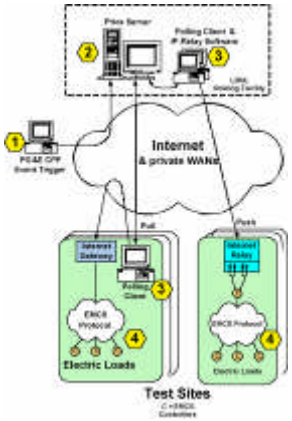
EPRI Smart Grid Demonstration:
Integrating Distributed Resources



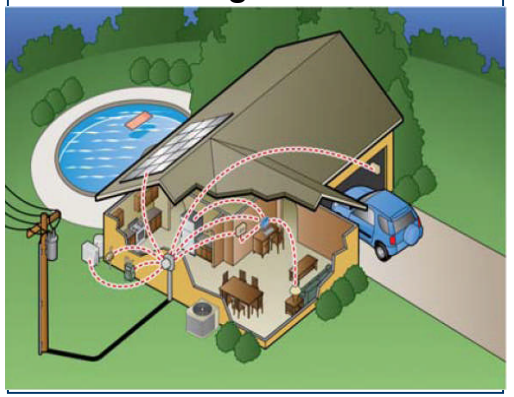
Smart Grid Infrastructure Used to Build an Integrated Dispatchable Demand-side Resource

Substation/Feeder Level Energy Storage

C&I Customer Demand Response & Distributed Generation



Residential Customer Demand Response & DER Integration



EPRI's IntelliGrid Architecture Will be the Foundation for The Smart Grid Demos

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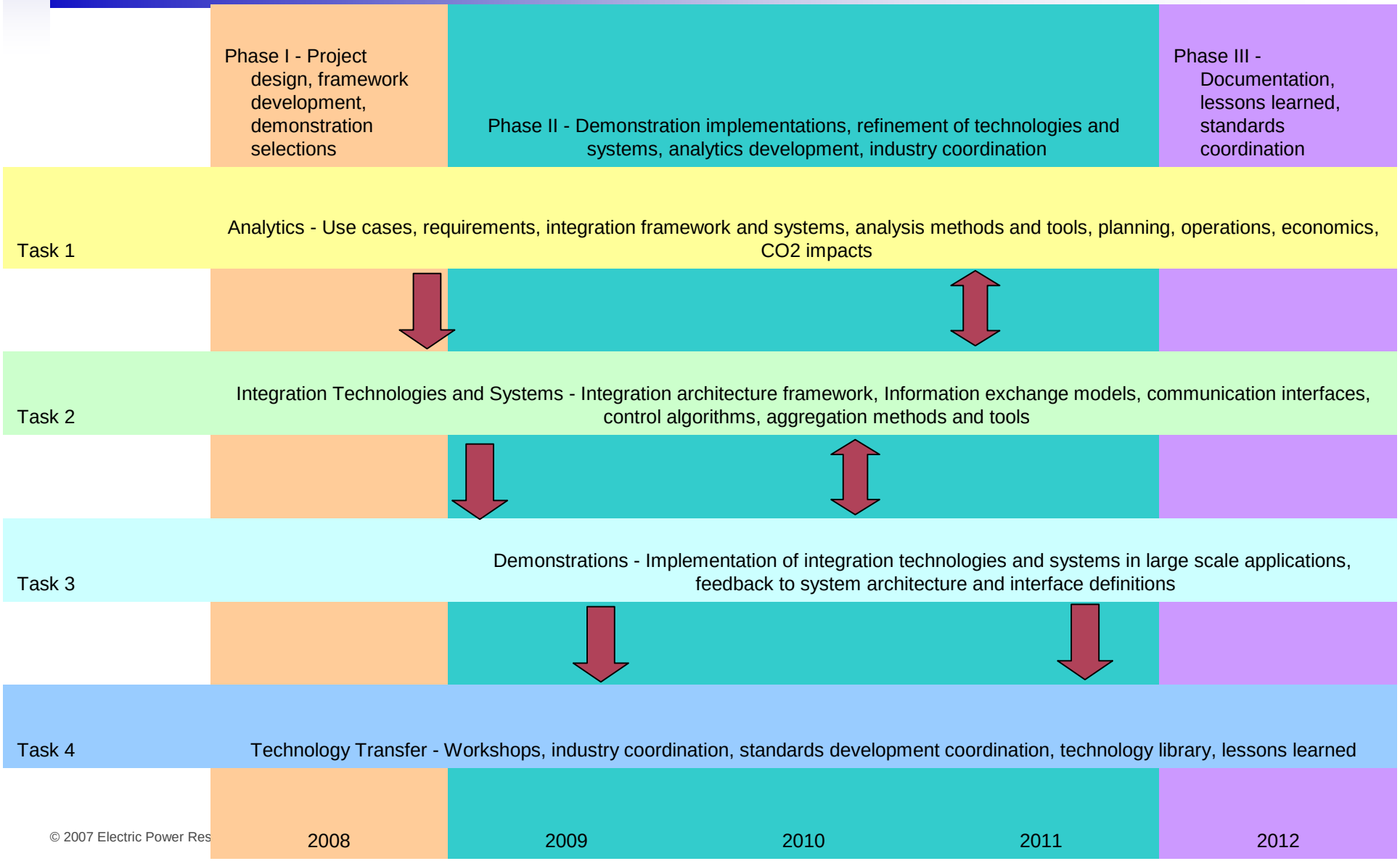
Smart Grid Demonstration Approach

- Utilize the information and communication infrastructure of the host utility to deploy a demand-side virtual power plant
- Coordinated with distribution system operation and planning
- Shared learning from multiple demonstrations
- Consistent methodology will lend to expandability, scalability, and repeatability
- Use cases lead to developing requirements specifications that will include interoperability and can be adopted by other utilities

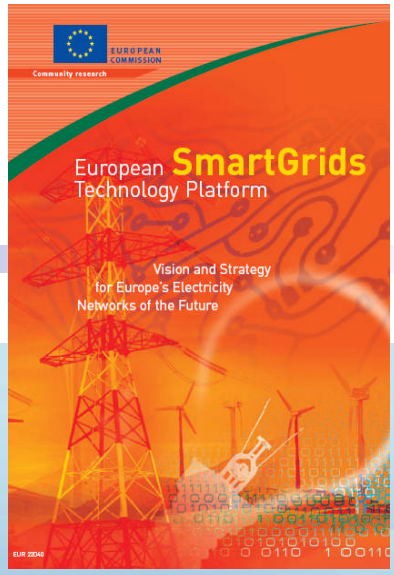
Smart Grid Demonstration: Project Overview

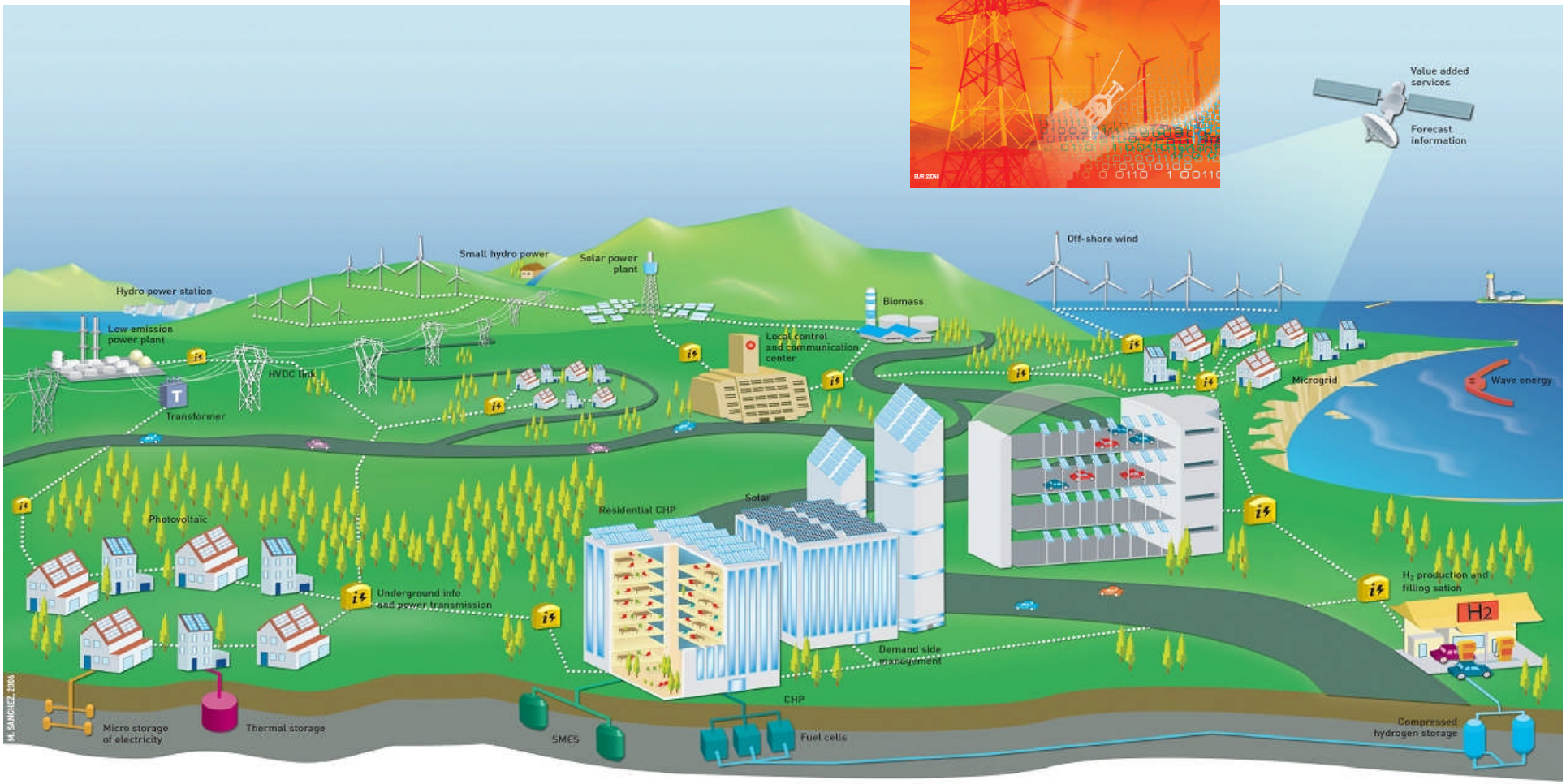


DOE Distribution Integration Awards

- Allegheny Power, WVU, NC State, Research & Development Solutions, Augusta Systems, Tollgrade – **West Virginia Super Circuit**
- ATK Launch Systems, Rocky Mountain Power, P&E Automation – **integration of renewables, DG, and storage (compressed air).**
- Chevron Energy Solutions, Alameda County, PG&E, VRN Power Systems, SatCon, Univ of Wisc., NREL, LBNL, E3 – **Solar, fuel cell and storage microgrid**.
- City of Fort Collins, Colorado State Univ, InteGrid Lab, Comm Found of Northern Col, Governor's Energy Office, Advanced Energy, Woodward Spirae, Eaton – **3.5 MW mixed distributed resources for peak load reduction**.
- IIT, Exelon/ComEd, Galvin Electricity, S&C – **"perfect Power" demonstration**
- Con Edison, Verizon, Innovative power, Infotility, Enernex – **Interoperability between utility and end use customers for DG aggregation.**
- SDG&E, Horizon Energy Group, Advanced Control Systems, PNNL, Univ of San Diego, Motorola, Lockheed Martin – **Integrating multiple distributed resources with advanced controls.**
- Univ of Hawaii, GE, HECO, MECO, Columbus Electric Coop, NM Inst of Mining and Tech, Sentech, UPC Wind – **Mgt of distributed resources for improved quality and reliability, grid support, and transmission relief**.
- Univ of Nevada, Pulte Homes, Nevada Power, GE Ecomagination – **Integrated PV, battery storage, and consumer products with advanced metering**.

European SmartGrid Demonstration Projects





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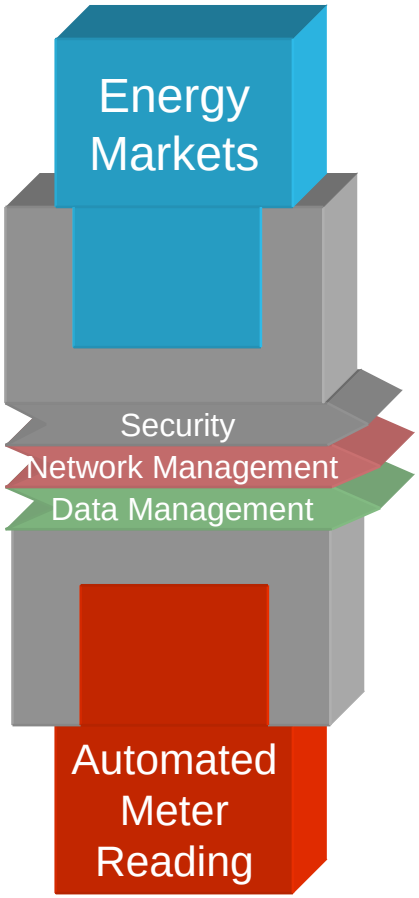
Using IntelliGrid Methodology to Develop the Smart Grid Architecture

- **Business Case/Cost Benefit Analysis**
- **Define Requirements of Each Smart Grid Application using the Use Case Process**
- **Design an Architecture for Security, Data Management and Network Management**
- **Select Technologies, Finalize Cost Benefit Assessment**



EPRI's IntelliGrid Methodology is Accepted as an International Recommended Specification and an Industry Best Practice to Architect a Smart Grid

Smart Grid Information Clearinghouse

- **Background Documents** – white papers, executive summaries, important high level references
- **Standards Reference** – including current status of standards and links to the activities under way
- **Projects Database** – smart grid projects, objectives, contacts, status
- **Use Case Library** – defining requirements for smart grid applications
- **Technology Library** with smart grid requirements organized as a function of technology and application
- **Business cases** – costs and benefits of smart grid applications
- **Application experience and lessons learned** from actual demonstrations

Together…Shaping the Future of Electricity