

ABB Automation & Power World: April 18-21, 2011

WPS-139-1

Smart Grid Introduction

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Smart Grid Introduction

- Speaker name: Gary Rackliffe
 - Speaker title: VP Smart Grids North America
 - Company name: ABB Inc.
 - Location: Raleigh, NC
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- Speaker name: Kenneth Grant
 - Speaker title: Director Positive Energy®
Smart Grid Programs
 - Company name: OGE Energy Company
 - Location: Oklahoma City, OK

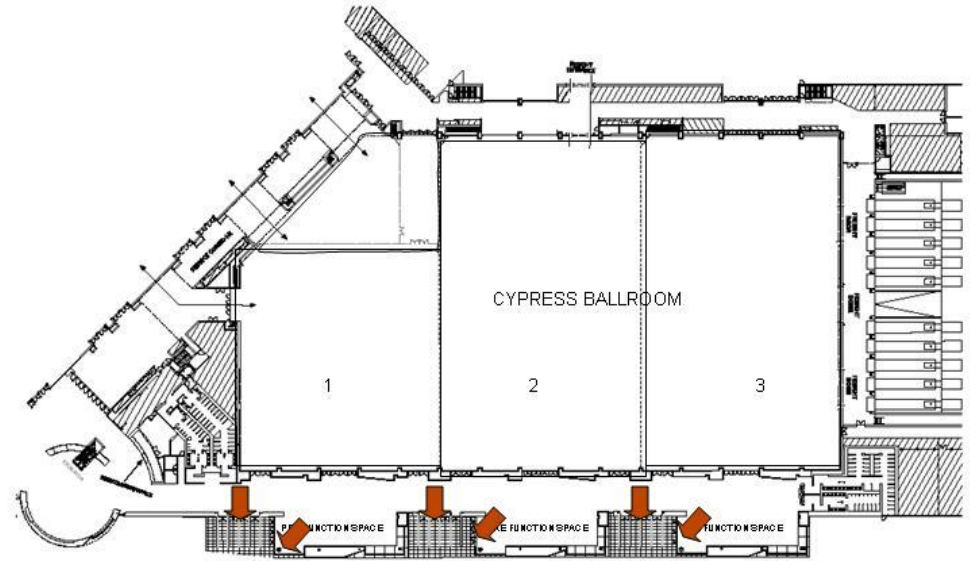
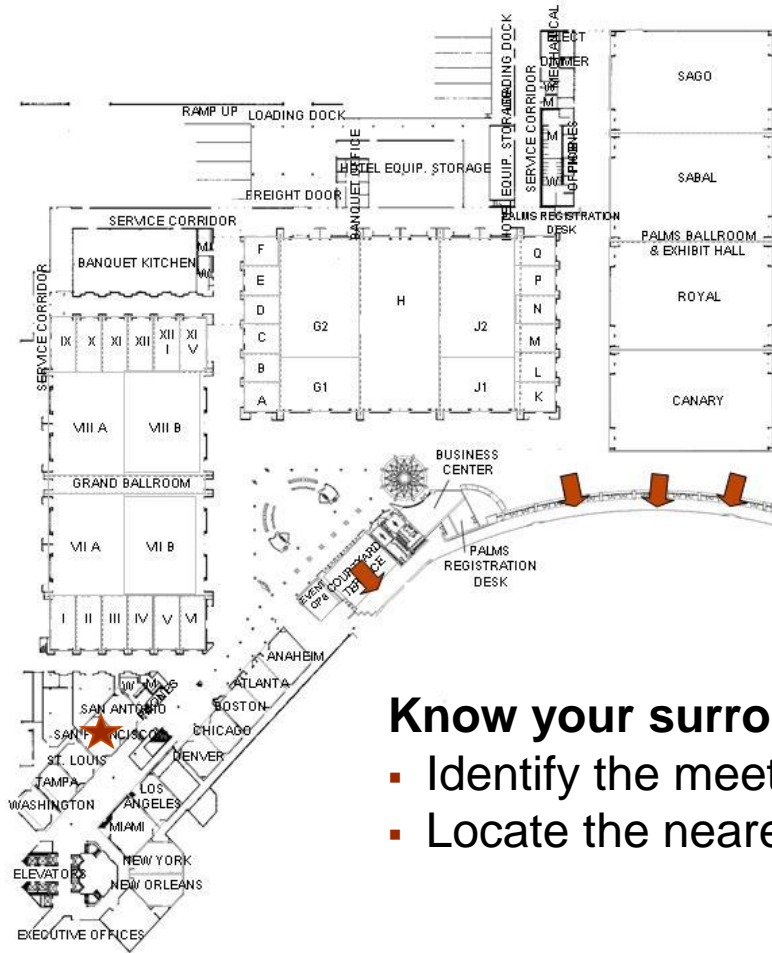
Your safety is important to us

Please be aware of these emergency procedures

- In the event of an emergency please dial ext. **55555** from any house phone. Do not dial 9-1-1.
- In the event of an alarm, please proceed carefully to the nearest exit. Emergency exits are clearly marked throughout the hotel and convention center.
- Use the stairwells to evacuate the building and do not attempt to use the elevators.
- Hotel associates will be located throughout the public space to assist in directing guests toward the closest exit.
- Any guest requiring assistance during an evacuation should dial “0” from any house phone and notify the operator of their location.
- Do not re-enter the building until advised by hotel personnel or an “all clear” announcement is made.

Your safety is important to us

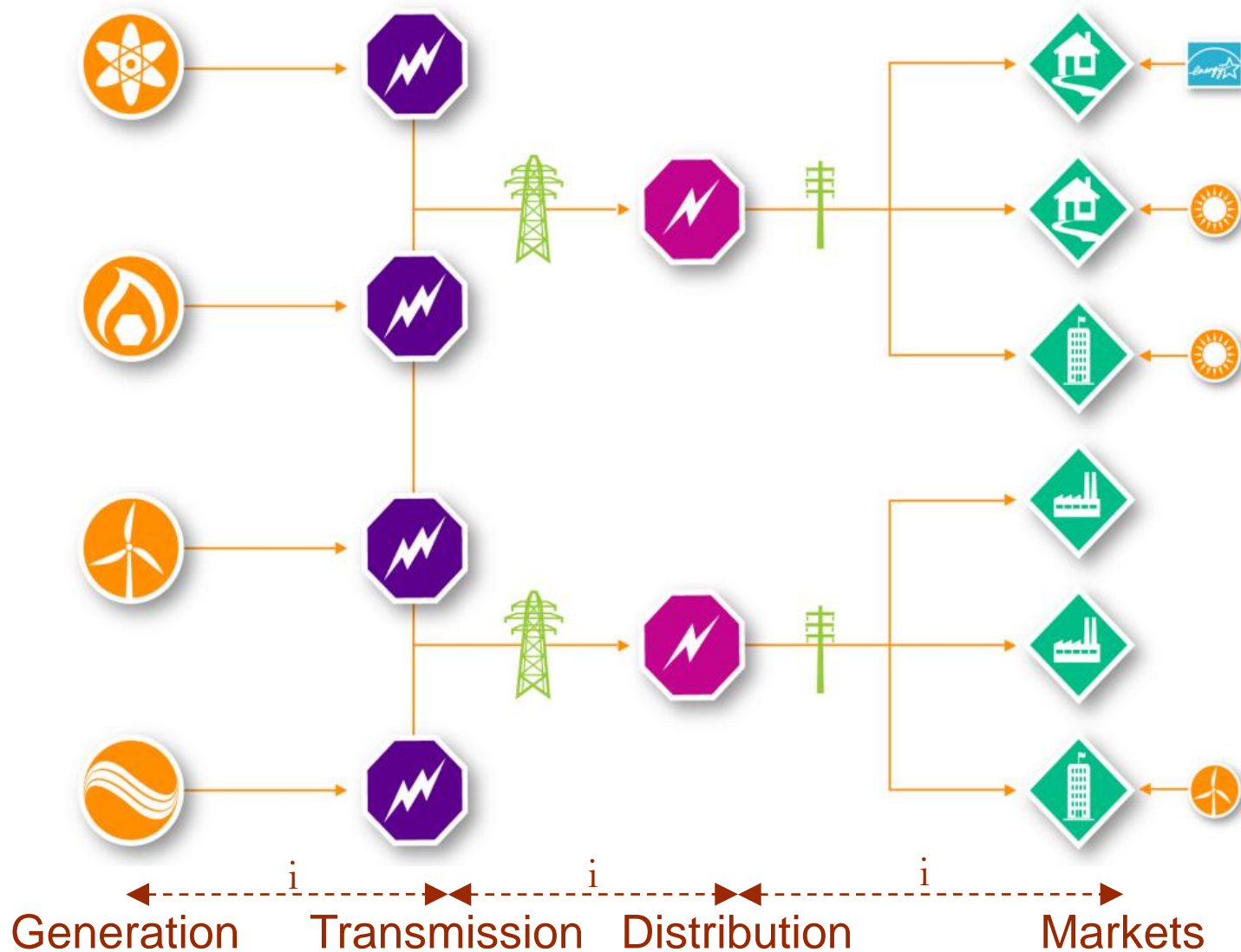
Convention Center exits in case of an emergency



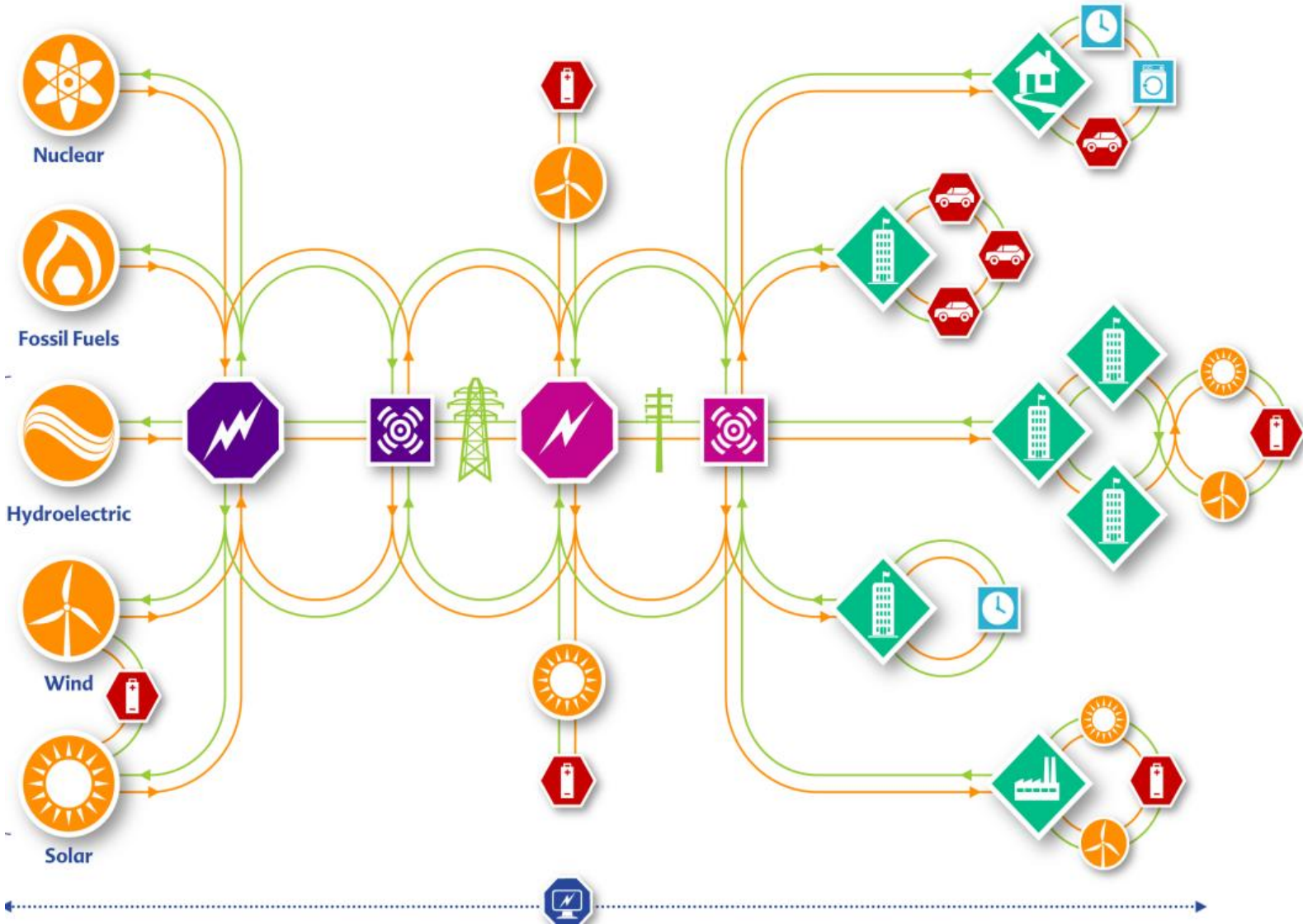
Know your surroundings:

- Identify the meeting room your workshop is being held in
- Locate the nearest exit

Current State



The Vision



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What is the potential market size?

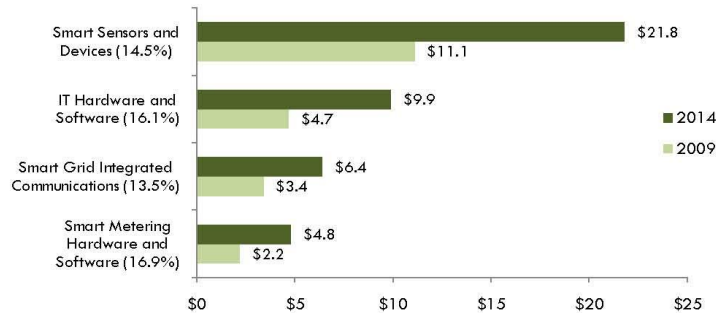


U.S. Hardware and Software Companies Should Prepare to Capitalize on the Smart Grid in the U.S. and in International Markets | [LEARN MORE BELOW](#)

December 2009

The major opportunities presented by the development of the Smart Grid are not just for utilities, power marketers, energy producers, investors and venture capitalists. In 2014, **89.0 percent or \$152.3 billion** of the global Smart Grid market is projected to be comprised of devices, hardware, software, and communications equipment. These products will form the infrastructure and critical communication systems which will build, link, monitor, manage and secure the Smart Grid. Of course not every hardware or software company will have the resources, technology or engineering expertise to compete in this market, but those with the resources and a flexible knowledge base should at the very least explore new product opportunities within the emerging Smart Grid market.

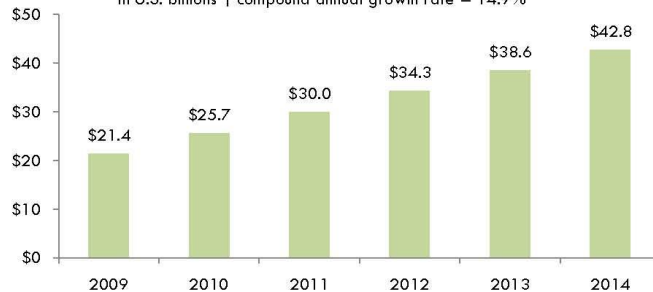
Projected U.S. Smart Grid Market by Technology, 2009 and 2014
in U.S. billions | (compound annual growth rate in parentheses)



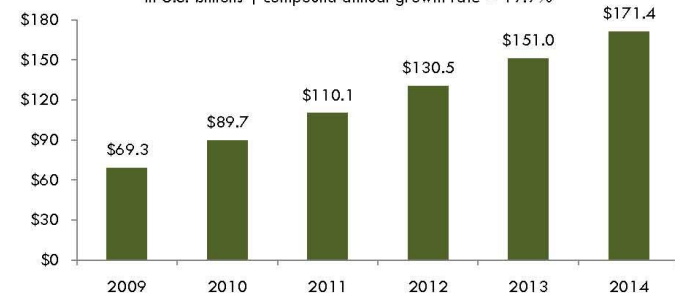
Projected Global Smart Grid Market by Technology, 2009 and 2014
in U.S. billions | (compound annual growth rate in parentheses)



Projected U.S. Smart Grid Market Size, 2009 - 2014
in U.S. billions | compound annual growth rate = 14.9%



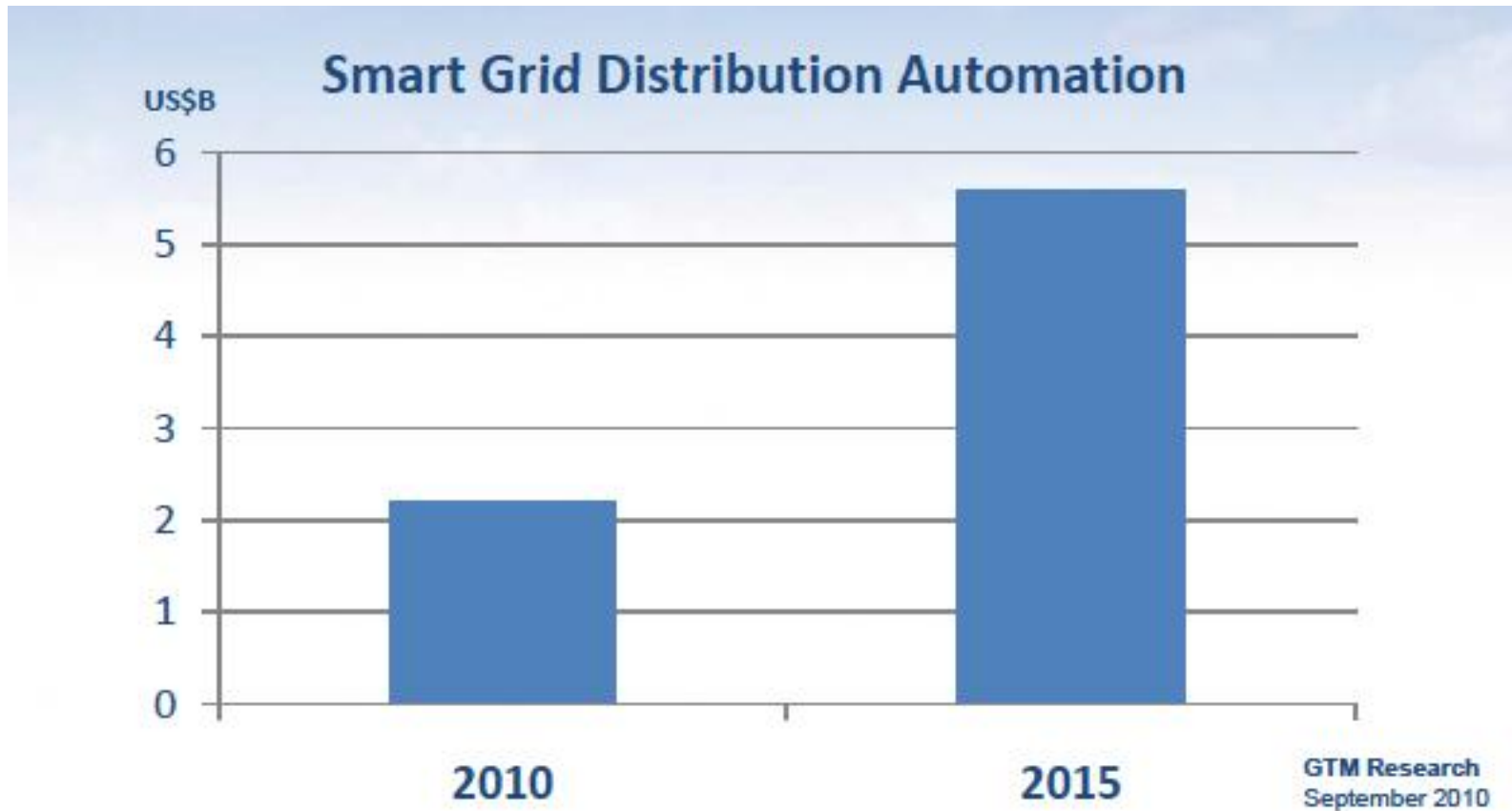
Projected Global Smart Grid Market Size, 2009 - 2014
in U.S. billions | compound annual growth rate = 19.9%



Data: SBI Reports



What is the potential market size?



Smart Grid Investments

R&D:

- Communications and systems integration
- Energy storage solutions – GM collaboration to re-purpose Chevy Volt batteries
- Power electronic applications such as hybrid transformer
- Relays and controllers supporting both DNP3.0 and IEC 61850

Investments:

- Distribution Automation Center of Excellence
- Trilliant – AMI and DA communications
- ECotality – Electric vehicle service equipment
- Industrial Defender – Cyber security
- HV Cable Manufacturing in Huntersville, NC
- Novatech Solar – Solar thermal energy applications

Acquisitions:

- Ventyx – Utility IT solutions for asset management, work management, mobile data, resource planning, electric market participation, demand response management and virtual power plant modeling
- Insert Key Solutions – Equipment reliability management
- Obvient – Business Intelligence, Asset Health Monitoring and Management
- RCCS – Volt/Var Management Systems
- Baldor – Energy efficient electric motors

Distribution Automation Center of Excellence

Distribution Automation Technology Center

1. **System Verification Center** for certifying customer solutions before field deployment
2. **Demonstration Center** to showcase ABB's Smart Grid technologies and partner collaboration for customers
3. **Test and Development Laboratory** to accelerate market entry with cross-BU and division solutions and with strategic partners

CoE Teams

1. **Development team** to continue targeted R&D for Distribution Automation offerings and solution development.
2. **Project team** to deliver customer-focused, end-to-end solutions
3. **Business support team** for system development, integration, product management, technical support, business development, and sales.

Smart Grid Technologies

Customer Implementation Strategies and ABB Vision

Information Technology



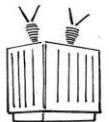
CIS



Comms



GIS



Asset Mngmnt



Work Mngmnt



Mobile Data

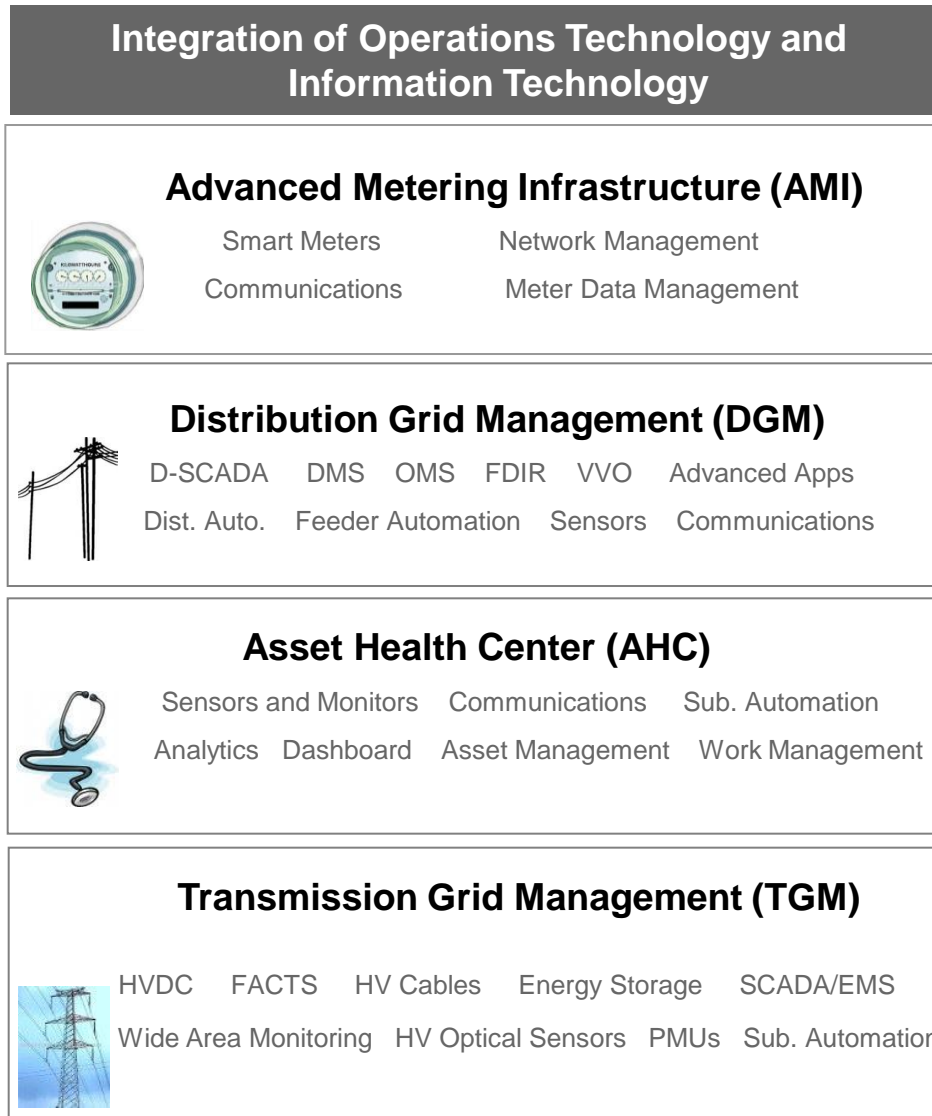


Security

- Utility Information Technologies that enable smart grid applications

Smart Grid Technologies

Customer Implementation Strategies and ABB Vision



- End-to-End Smart Grid Applications
- Operations and IT Integration

Smart Grid Technologies

Customer Implementation Strategies and ABB Vision

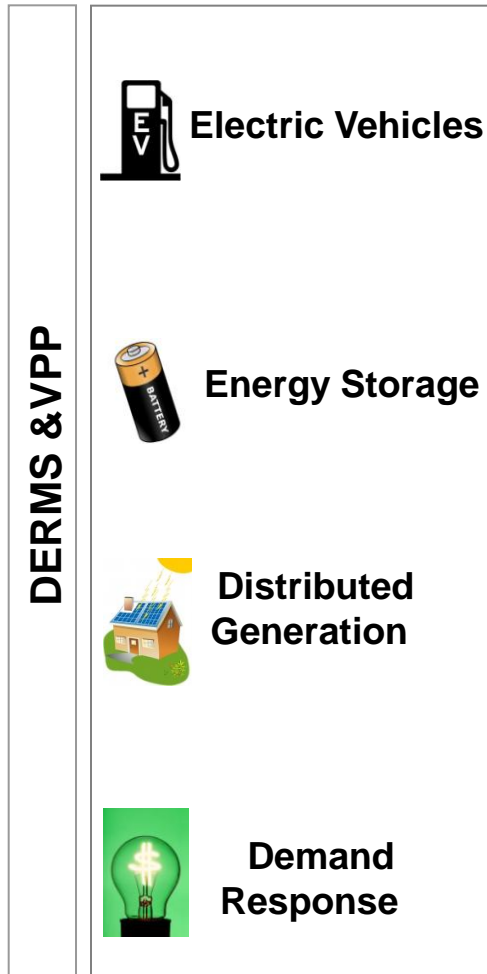
1. Distributed Energy Resource Management System to:

- Forecast and aggregate resources
- Model distributed energy resources as a Virtual Power Plant
- Manage customer registration and billing determinants
- Integrate to utility operations
- Manage commercial process of participating in demand response energy market

2. Distributed energy resources

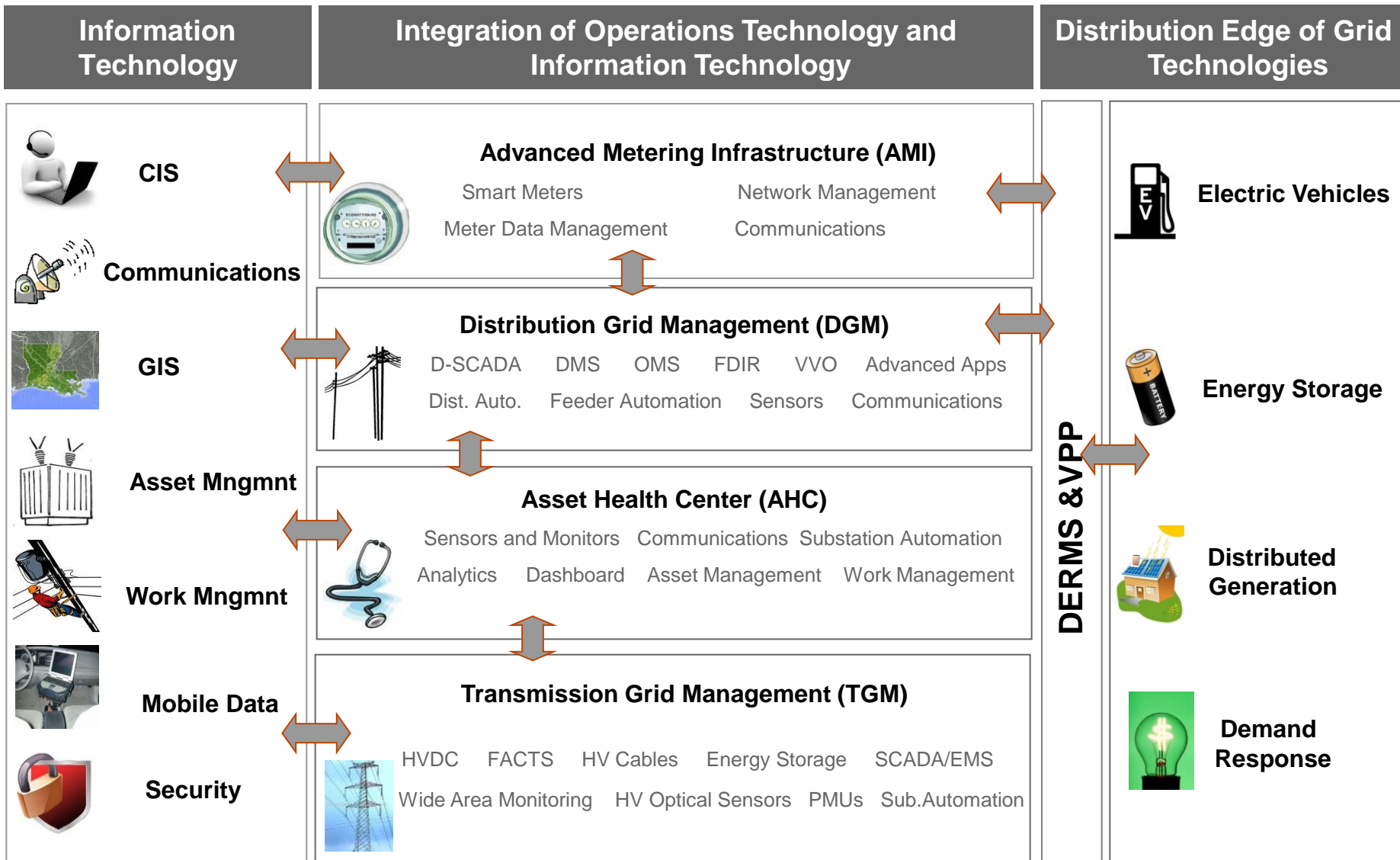
- EV charging service equipment
- Battery energy storage systems
- Solar PV systems
- Demand response via direct load control, real time pricing and time-of-use rates, and end user energy efficiency solutions

Distribution Edge of Grid Technologies



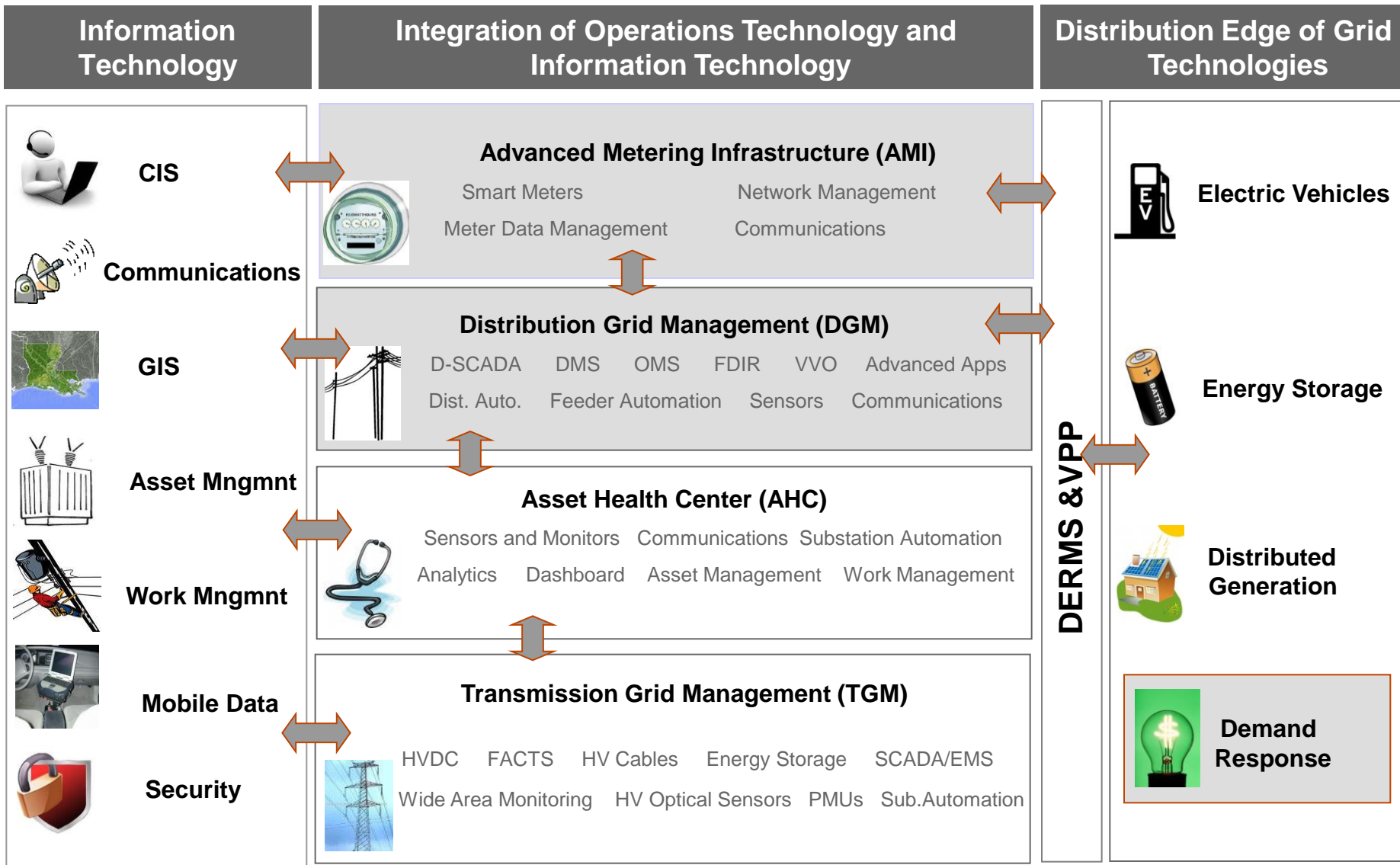
Putting It All Together

ABB Vision – Coverage of the Smart Grid Landscape



Putting It All Together

ABB Vision – Coverage of the Smart Grid Landscape





POSITIVE
ENERGY
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OG/E

Positive Energy® Smart Grid

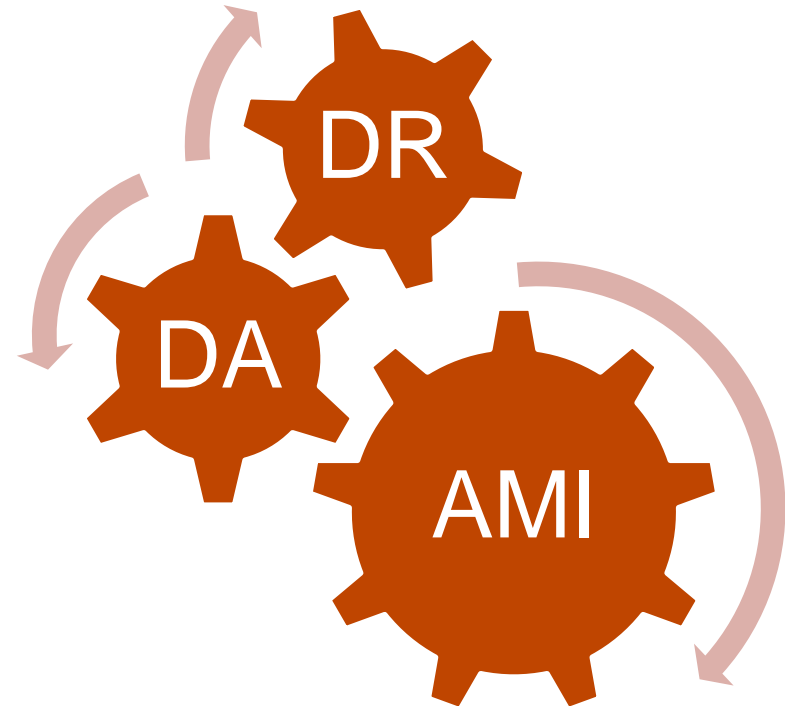
WITH ALL YOUR POWER  WHAT WOULD YOU DO?

ABB

Smart Grid:

Main Functional Areas

- Advanced Metering Infrastructure (AMI)
 - Smart meters for all customers
 - Wireless communications network
- Distribution Automation (DA) Technologies
 - Automated switching
 - Automated voltage control
 - Distribution Management System
- Demand Response (DR) Programs
 - Dynamic pricing
 - Energy information web-site
 - In-home devices



2020 Goal – *“Together, we can delay the need for new fossil-fueled power generation until 2020”*

- ✓ Additional wind generation
- ✓ Build transmission to deliver wind energy
- ✓ Focus on Demand Side Management
- ✓ Deploy Smart Grid technology

Smart Grid:

Expected Benefits

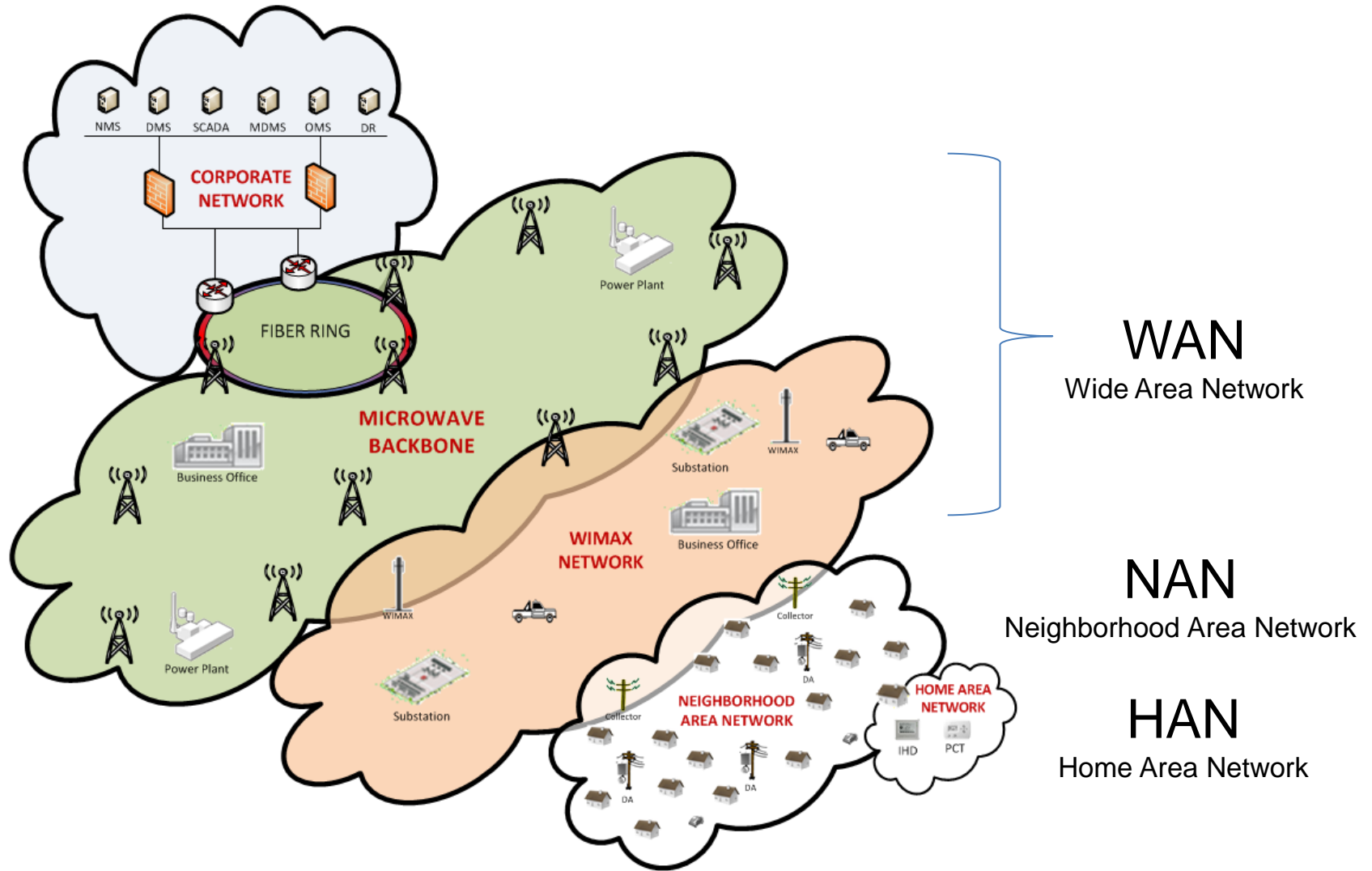
Customer, Company, & Environmental

- Fuel savings & peak load reduction
- Deferred generation capacity
- Operational savings from avoided “truck rolls”
- Improved management of outages & reliability
- Enhanced customer service and improved satisfaction
- Reduced emissions from power generation and vehicle use
- Improved theft detection



Advanced Metering Infrastructure

Multi-Tiered Network Architecture



AMI / Meters & Local Area Network:

- Business objectives
 - Reduce operating costs through remote meter reads and remote meter connections and disconnections
 - Environmental benefits from reduced vehicle miles
 - Platform to support demand response & new products / services
 - Improve outage management
- Scope:
 - 760,000 meters (250,000 installed as of April, 2011)
 - 600 AMI mesh access points
 - Approximately 1600 AMI repeaters (Relays)
- Metrics: # of “truck rolls” avoided, # of meters reporting daily, vehicle miles avoided, theft reduction, consumption on inactive meters

AMI / Wide Area Network:

- **Business Objectives**
 - Provide communications backhaul for all AMI & mission-critical automation devices
- **Scope:**
 - Microwave backbone: Approx. 40 sites
 - WiMAX “middle mile”
 - Approx. 70 master sites (utilizing some cell-net as well)
 - Approx. 3800 end points (SilverSpring Networks access points, reclosers, feeder meters, capacitor controllers)
- **Metrics: Availability, utilized capacity, latency, # of incidents of equipment failure**



Demand Response

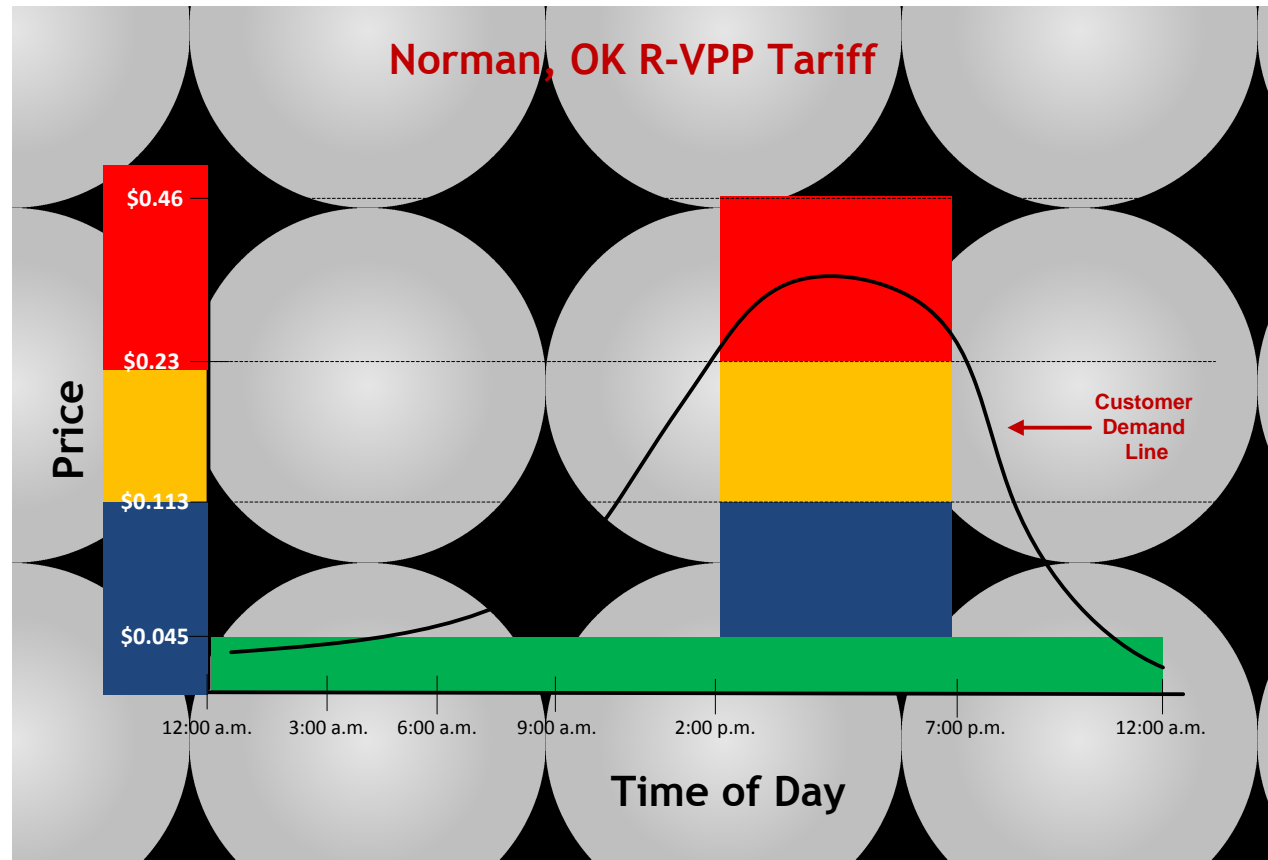
Demand Response:

Dynamic Pricing & In-Home Technology

- Business objectives: Provide information and pricing incentive to motivate customers to manage energy consumption (reduce peak demand)
 - Significant component of our plan to defer all incremental fossil-fuel capacity to 2020
 - Voluntary programs, customers maintain full control of usage at all times
- Scope:
 - Study sample & period: 3000 customers in 2010 & 6000 customers in 2011
 - Means: web portal, in-home displays, programmable communicating thermostats
 - Penetration target: 20% (~160k customers) by 2016
- Metrics: Customer inquiries, customer complaints, customer retention, customer satisfaction, net promoter score, peak demand reduction, overall energy reduction, penetration

Energy Rates: *Dynamic Pricing*

- Peak demand
- Hours: 2 - 7 PM
- Monday - Friday
- June - September
- Customers receive day-ahead price via in-home display, web, text, email, etc.



All electricity is not created equally – as demand increases, the cost to generate and deliver electricity increases

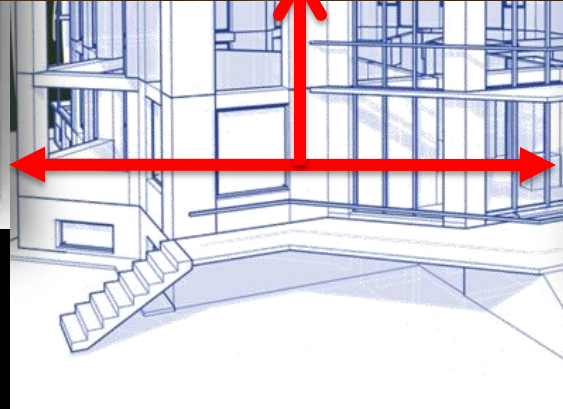
Study Design: Technology



Energate
Pioneer



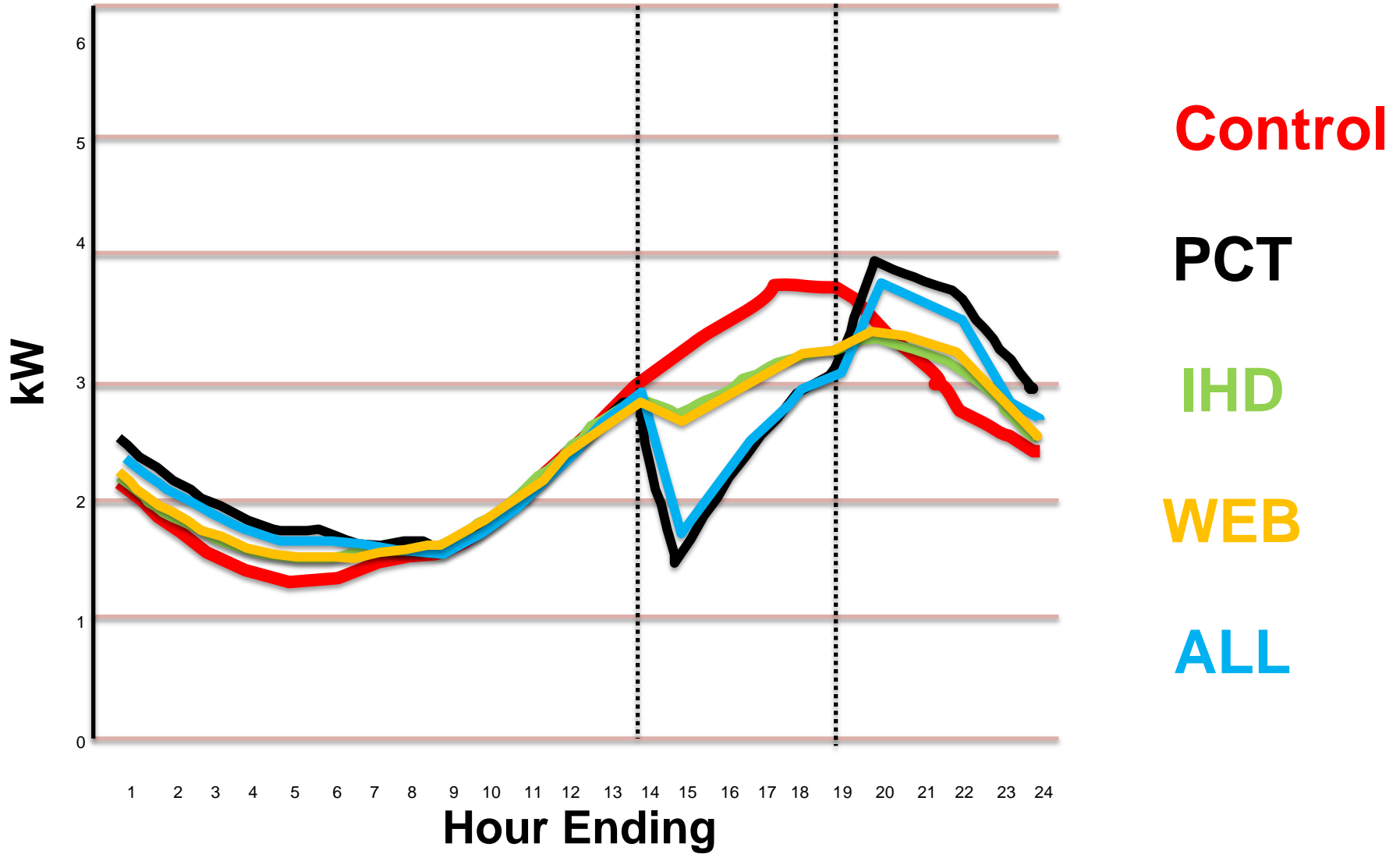
LSR RateSaver®



A screenshot of the OG/E website's 'My Report' page. The page features a red header with the OG/E logo and navigation tabs for 'My Report', 'Bill Analysis', 'Energy Use & Cost', 'My Neighborhood', and 'Environment'. The main content area includes a 'Smart Meter' icon, a 'Today I have used 23 kWh at a cost of \$1.78' notification, and a 'My Report' section with a 'Last meter read: Tuesday, January 25th, 9:30 AM'. Below this, there are three main sections: 'What will my bill be?' showing an estimated bill of \$121, 'What is my electricity use?' showing a bar chart for 652 kWh over 7 days, and 'What does my electricity cost me?' showing an average price of \$0.11 per kWh. Each section includes a 'View [Action]' button.

Silver Spring Networks

VPP/CP High Weekday



Energy Information Web-Site

Features:

- Current use
- Historical use
- Estimated bill
- Bill comparisons
- Environmental impact

Enroll at:

oge.com/myOGEpower

877-898-3834





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Distribution Automation Technologies

Distribution Automation Technologies:

- Eight year plan - began in Spring 2010
- Reclosers
 - Continuously improve reliability, reduce outage footprint & improve outage management
 - 500 devices for 200 circuits
- Capacitor controllers/monitors (IVVC Concept)
 - For reduction of losses & demand reduction at peak load
 - Improved voltage regulation
 - Significant component of our plan to defer incremental fossil-fuel capacity to 2020
 - 2400 devices for 400 circuits
- Fault current indicators (FCIs)
 - To improve fault location detection – improve reliability, crew management & outage management
 - Will test these devices to verify performance, locations & ultimate deployment
- Metrics: SAIFI, CAIDI, CMI, peak demand reduction, average % power factor correction

Distribution Management System:

- **Business Objectives:**
 - Provide integrated control system & operator interface for distribution system automation and optimization
 - Reduce outage time & improve reliability
 - Reduce peak demand & Improve system efficiency
- **SCADA functionality & advanced applications:**
 - Fault detection, isolation & service restoration
 - Fault location
 - Load flow analysis
 - Switching analysis & execution
- **Metrics: DMS availability, # of automated fault isolation/restoration operations through DMS**

Uses for AMI Data & Information: Grid Operations

- Circuit Loading
 - DMS will utilize meter load shapes
- Outages
 - Integration of OMS and AMI
 - Last Gasp messages
 - Nested Outage detection
 - Restoration Confirmation
 - Customer Notification
 - Identify customer side outages



- Power Quality
 - Sags/Swells
 - Harmonics
- Voltage from bellwether meters
 - Voltage profiles
 - Feedback for Volt-VAr optimization



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Reminders

Automation & Power World 2011

- Please be sure to complete the workshop evaluation
- Professional Development Hours (PDHs) and Continuing Education Credits (CEUs):
 - You will receive a link via e-mail to print certificates for all the workshops you have attended during Automation & Power World 2011.
 - **BE SURE YOU HAVE YOUR BADGE SCANNED** for each workshop you attend. If you do not have your badge scanned you will not be able to obtain PDHs or CEUs.

Power and productivity
for a better world™

