

Smart Grid

January 11, 2012



Joshua Jones, PE



Proudly serving our customers for 100 years.

A Century of Service

For 100 years, customers in Idaho, Utah and Wyoming have “flipped a switch” and Rocky Mountain Power has powered their lives with safe and dependable electric service



A Century of Service



- Salt Lake City was the fifth city in the world to have central station electricity behind only London, New York City, San Francisco and Cleveland.
- The Company was formed in 1912 with 39,700 customers
- Now, we serve over 1.8 million customers – and growing...



About PacifiCorp

- Customers 1.8 million
- Employees 6,447
- Territory 136,000 sq. mi.
- Distribution
 - ✓ 817 Substations
 - ✓ 62,000 Line Miles
- Transmission
 - ✓ 262 Substations
 - ✓ 15,900 Line Miles
- Generation
 - ✓ 78 Plants
 - ✓ 10,483 MW Capacity
 - 3,100 MW Renewable

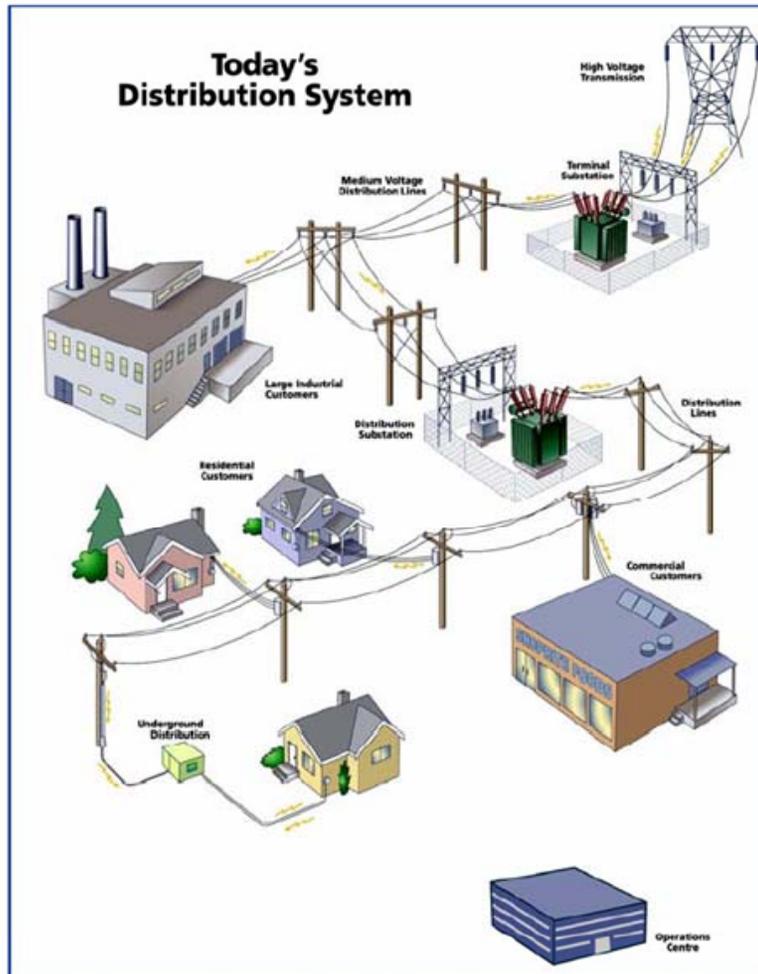


Recent Studies at PacifiCorp

- Automated Meter Reading / Advance Metering Infrastructure – 2008 Strategy Paper
 - Created smart grid working group
- Smart Grid: A Functionality and Business Review
 - Identified the need for the smart grid department
- State Smart Grid Reports
(Utah, Wyoming, Oregon, Washington)
- Rooftop Solar Study



Today's Electrical System



- Human intervention is a large part of how the system is operated today.
- The “smart grid” will enable equipment to automatically perform tasks by using data and logic to make decisions.

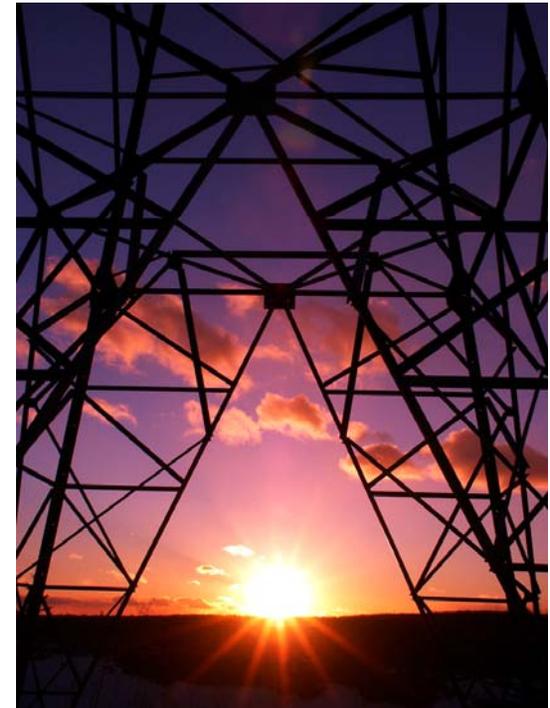
The “Vision” of Smart Grid

- Improves reliability, security and efficiency of transmission and distribution systems.
- Integrates renewable and distributed resources and generation.
 - Integrates advanced electricity storage and peak shaving technologies.
- Provides consumers timely information and control options.
 - Incorporates demand response, demand-side and energy efficiency resources.
- Reduces the cost of generation and delivery of electricity.

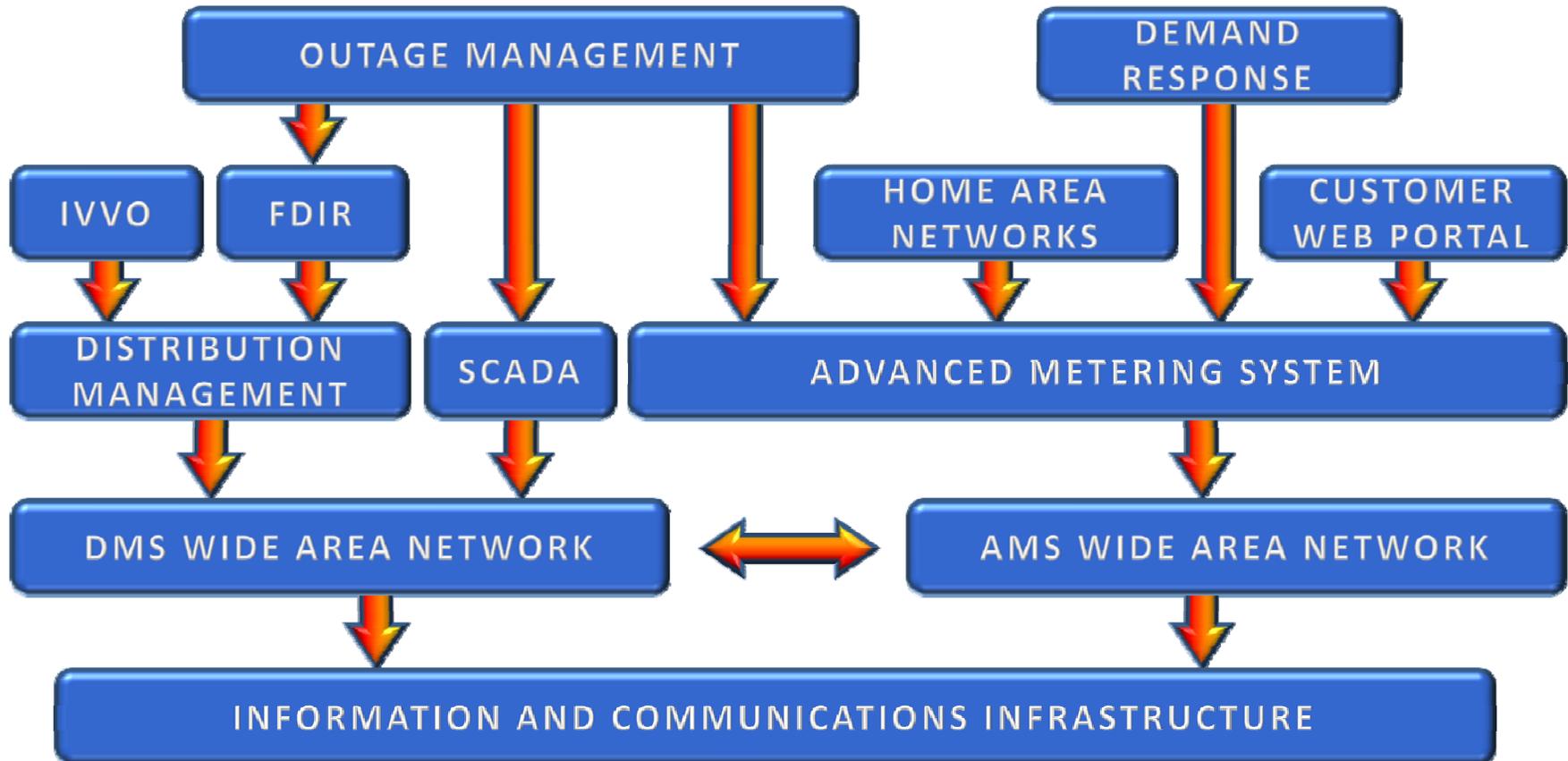


Defining “Smart Grid” for PacifiCorp

- Advanced Metering System
- Demand Response
 - Home Area Networks
- Distribution Management System
 - Interactive Volt-Var Optimization
 - Conservation Voltage Reduction
 - Capacitor Bank Maintenance
 - Centralized Energy Storage
- Outage Management System
 - Fault Detection, Isolation and Restoration
- Transmission Synchrophasors

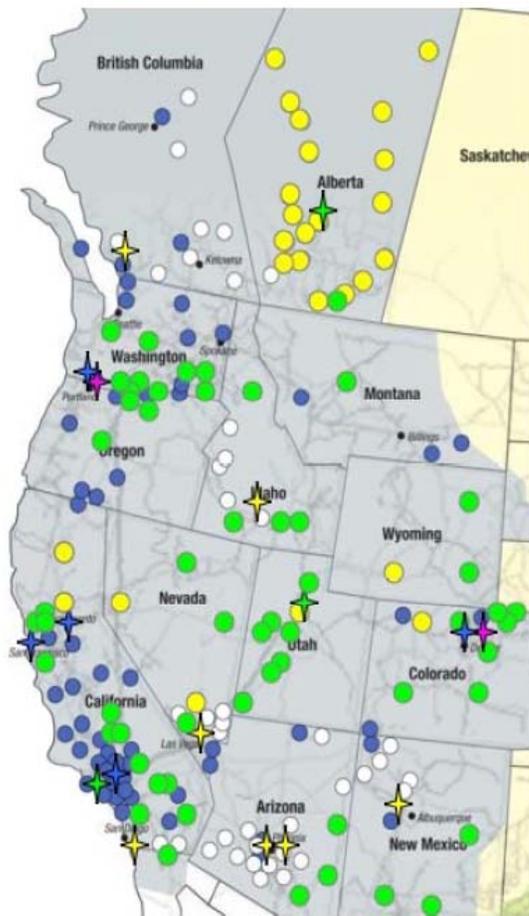


Technology Dependencies

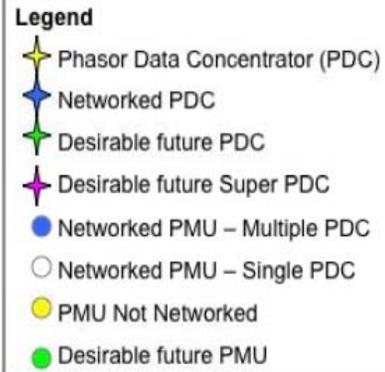


Transmission Synchrophasors

- WECC Demonstration Project



Phasor Measurement Units (PMU) in the Western Interconnection



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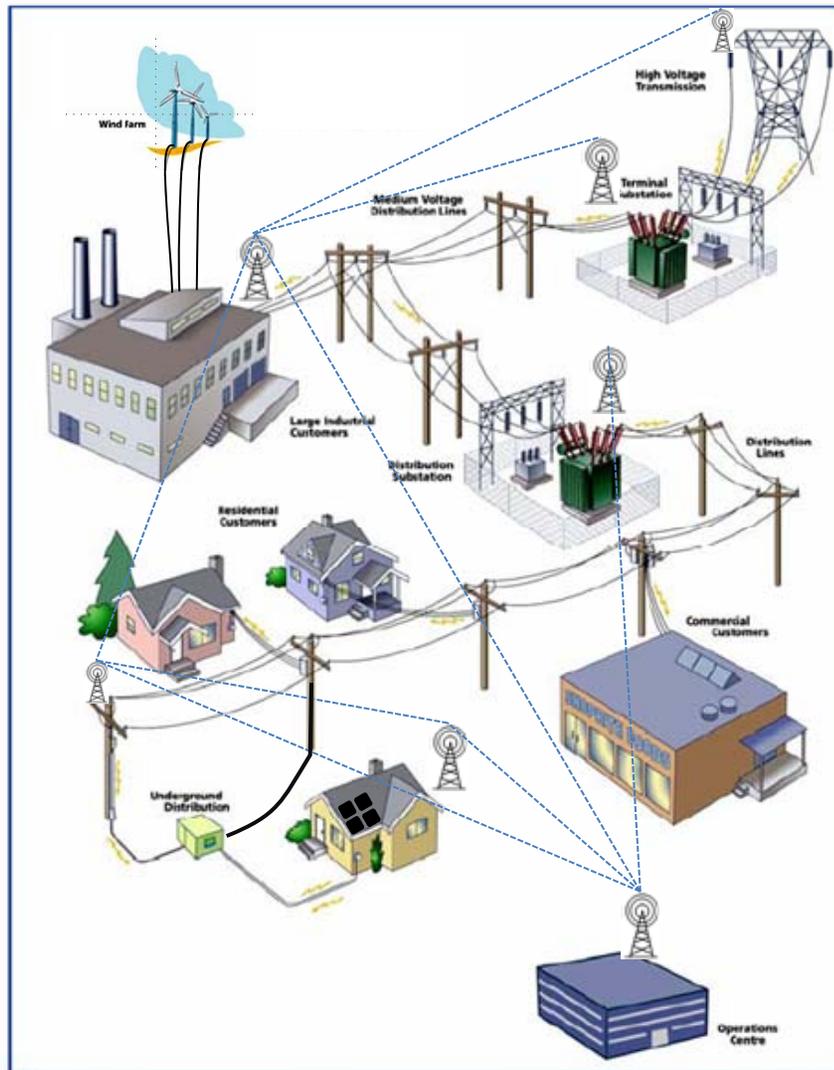
Distribution Management System

- Interactive Volt-Var Optimization (IVVO)
 - “Intelligent” Capacitor Banks and Regulators
 - Improved Circuit Efficiency
 - Reduced Distribution System Losses

- Fault Detection, Isolation and Restoration (FDIR)
 - “Smart” Reclosers and Faulted Circuit Indicators
 - Improved Circuit Reliability
 - Reduced Customer Minutes Interrupted



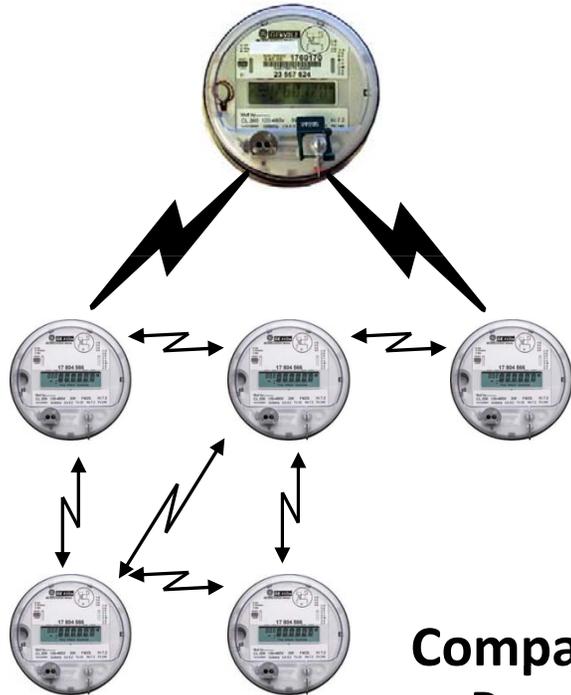
Smart Grid – Tomorrow's Distribution System?



- Add Redundancy
- Add Communications
- Integrate Renewables
- Automate Devices

Advanced Metering

ADVANCED METERING SYSTEM



Customer Benefits

- Real-Time Monitoring of Energy
- Home Area Networks
- Price Demand Response
- Plug-in Electric Vehicles

Company Benefits

- Dynamic Pricing
- Remote Disconnect
- Load Control Devices
- Distributed Renewables

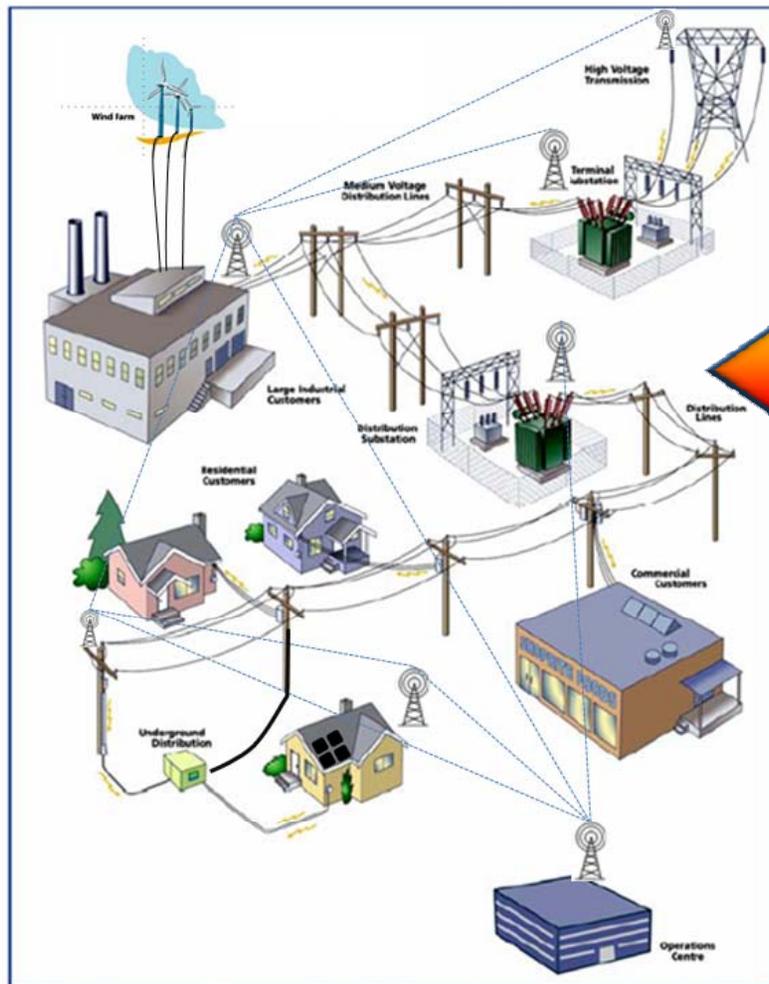
Home Area Network



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The Transition Point

Utility



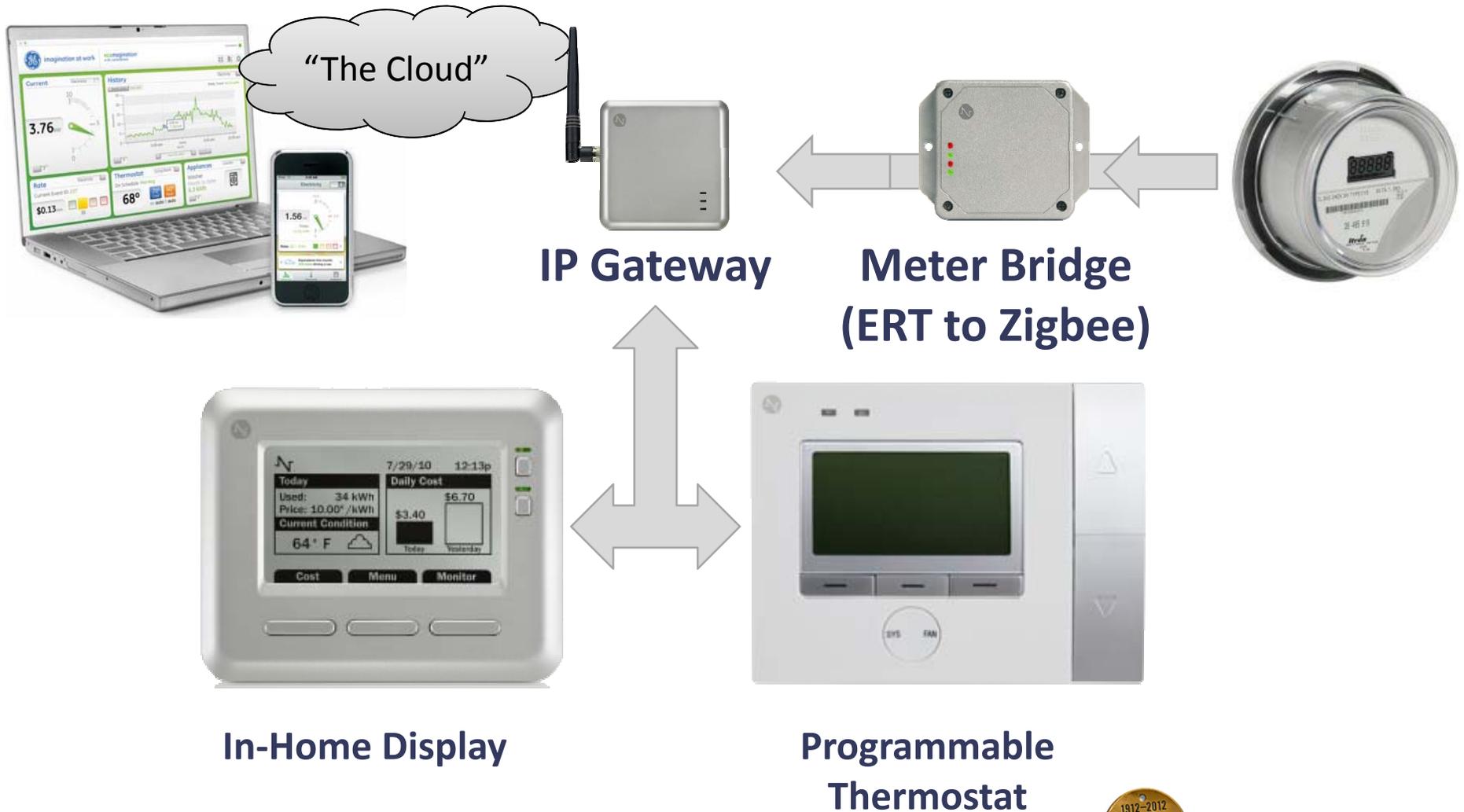
Customers



Customer Energy Management



Leveraging AMR -> AMI



Home Energy Management

The screenshot displays the GE Home Energy Management interface. At the top, the GE logo and "imagination at work" slogan are on the left, and "ecomagination™ a GE commitment" is in the center. On the right, there is a "Nucleus Connection" indicator and three utility icons. The main content area is divided into several sections. A large green-bordered window is centered on the "Thermostat" control for the "Living Room".

Thermostat - Living Room

Temperature: **68°**

Settings:

- Cool: 70°
- Heat: 60°
- System Mode: Auto
- Fan Mode: Auto

Current Status:

Today's Schedule:	Morning	Day	Evening	Night
4:00am	9:00am	4:15pm	8:00pm	
70° Cool	60° Heat	80° Cool / 52° Heat	78° Cool / 65° Heat	78° Cool / 58° Heat

Additional interface elements include "Current" energy usage (3.76 kWh), "Appliance" usage (Washer: 6.3 kWh), and a "Today's Schedule" section with "Hold" and "View Schedule" buttons.



Estimated Costs and Benefits

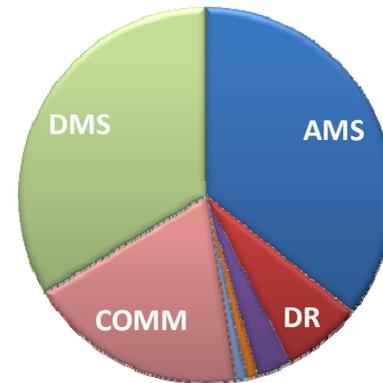


Case 6 - PacifiCorp Smart Grid Project

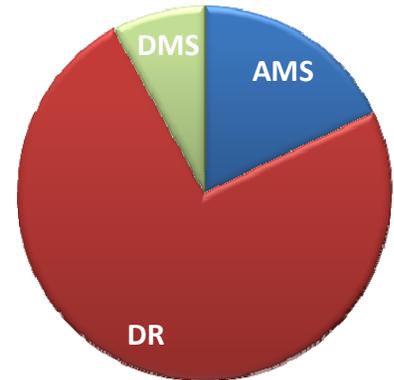
Smart Grid Financial Summary (thousands of dollars)

	CapEx Costs		Annual OpEx Costs		Annual Benefits
1 Information Technology	\$ -	1%	\$ -	3%	
2					
3 Communications Infrastructure	\$ -	19%	\$ -	28%	
4 AMS / DMS Wide Area Network	-		-		
5 Distribution SCADA Network	-		-		
6					
7 Advanced Metering System	\$ -	36%	\$ -	11%	\$ - 18%
8 Meter Reading Savings	-		-		-
9 Field Collection Savings	-		-		-
10 Estimated Billing Savings	-		-		-
11 Reduction in Energy Theft	-		-		-
12 Meter System Losses	-		-		-
13					
14 Demand Response	\$ -	7%	\$ -	16%	\$ - 74%
15 Energy Cost Savings	-		-		-
16 Capacity Cost Savings	-		-		-
17 Avoided Cool Keeper Costs	-		-		-
18					
19 Distribution Management	\$ -	34%	\$ -	29%	\$ - 8%
20 Distribution Management System	-		-		-
21 Interactive Volt/Var Optimization	-		-		-
22 Fault Detection Isolation Restoration	-		-		-
23 Centralized Energy Storage	-		-		-
24					
25 Outage Management	\$ -	-	\$ -	-	\$ - -
26 Call Center Savings	-		-		-
27 Trouble Dispatching Savings	-		-		-
28 Trouble Investigation Savings	-		-		-
29					
30 Transmission Synchroasors	\$ -	3%	\$ -	4%	
31					
32 Smart Grid Business Unit	\$ -		\$ -		
33					
34 Customer Education Program	\$ -	1%	\$ -	-	
35					
36 TOTAL COSTS and SAVINGS	<u>\$ -</u>		<u>\$ -</u>		<u>\$ -</u>

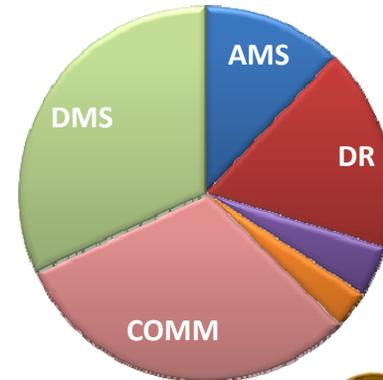
CapEx



Benefits



OpEx



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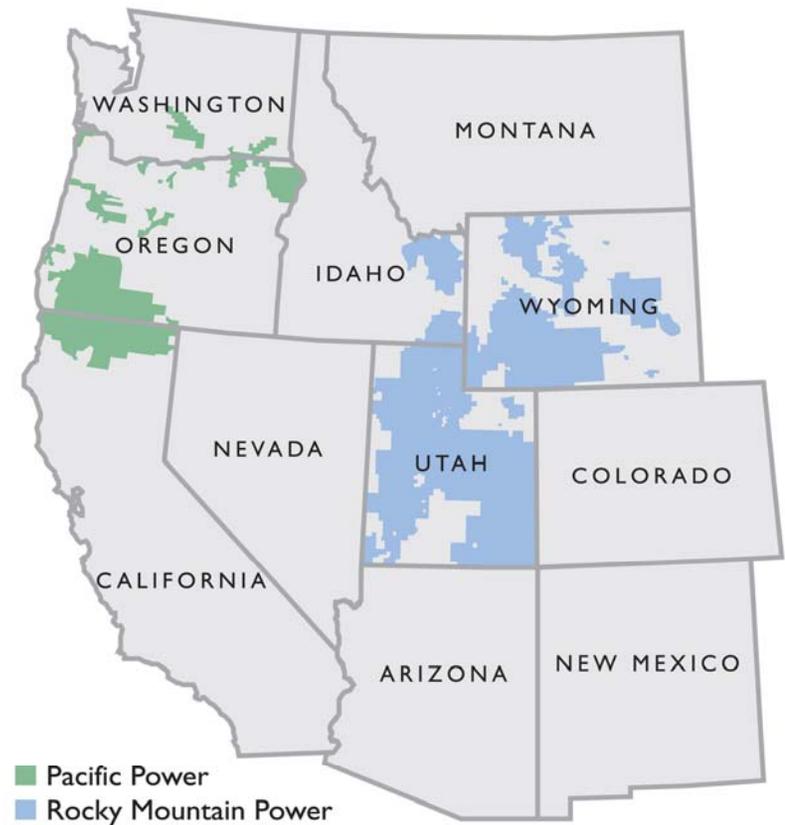
Challenges

- Standards and Interoperability
- Legislative and Regulatory
- Security of Customer and Company Data
- Distributed Generation
 - Protection Schemes
 - Electric Vehicles
- Customer Communication
- Customer Participation



Hurdles for PacifiCorp Smart Grid

- Low Energy Prices
- Customer Demographics
- Large Financial Investment
 - Company Infrastructure
 - Customer Expenses



Preparing for the Future



- Master Planning
 - Substation Design
 - Distribution Planning
 - Communications
- Standards
 - Review and Update
- Leverage Existing Investments

Smart Grid

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