Smart Grid Update

U.S.-JORDAN ELECTRIC POWER TRANSMISSION PARTNERSHIP

EXECUTIVE EXCHANGE VISIT

Barbara Lockwood, Tony Tewelis, Les Rainey
April 6, 2010

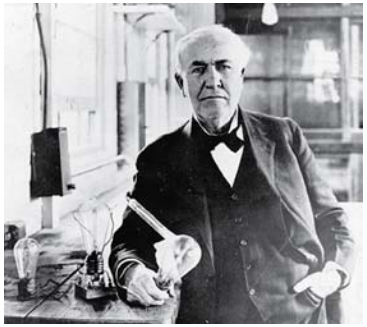
Agenda

Smart Grid Overview	**Lockwood**	**20 minutes**
Flagstaff Pilot Project	Rainey	20 minutes
Demand Response and the Smart Customer	Tewelis	20 minutes
Discussion	All	30 min

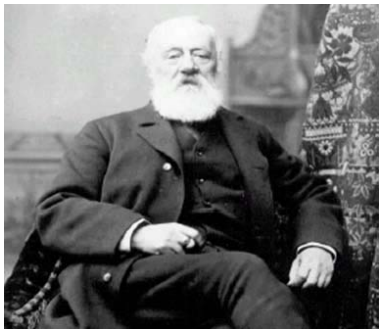
Smart Grid Objectives

An advanced delivery system, from generator to consumer, that provides enhanced operational capabilities

- Ensure EFFICIENT use of the electric grid
- Enhance RELIABILITY of the grid through early detection and automated “self-healing” technologies
- Provide CUSTOMERS with the information and tools to respond to electric grid conditions
- Improved CUSTOMER SATISFACTION
- Provide opportunities for NEW PRODUCTS AND SERVICES



Edison vs. Graham Bell:
The case for revitalization



THOMAS EDISON MEETS BILL GATES

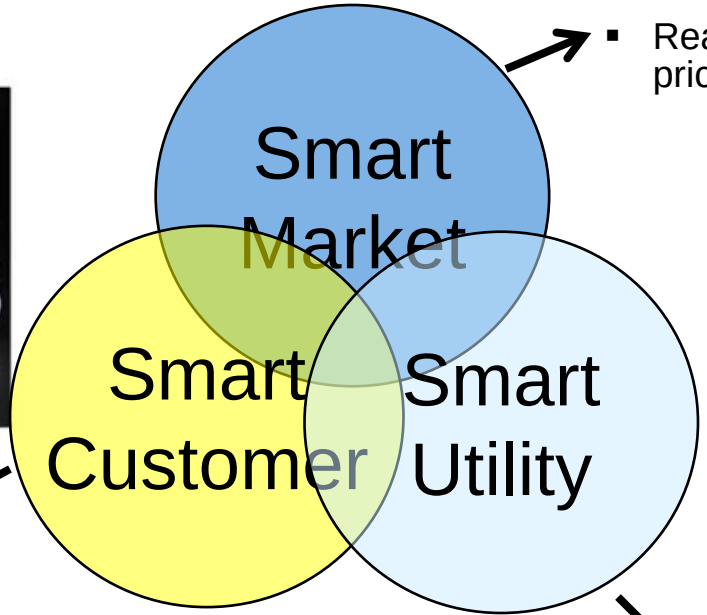
FROM TRANSFORMERS TO TRANSFORMATION

The Grid Today	The Grid Tomorrow
Electromechanical analog	Digital
Minimal communications (if any)	Ubiquitous two-way communications
Centralized generation	Distributed generation
Radial topography	Network topography
Few sensors	Ubiquitous monitors and sensors
"Blind"	Self-monitoring
Manual restoration	Semi-automated restoration; self-healing
Failures and outages	Adaptive protection and "islanding"
Manual equipment checking	Remote equipment checking
Emergency decisions made by committee/phone	Decision support systems, predictive reliability
Limited control over power flows	Persuasive control systems
Limited price information	Full price information
No consumer influence/involvement	Consumer influence/involvement

Source: Gridwise Alliance

A Vision for Smart Grid

- Authorized cost recovery
- Protocols, standards
- Real-time pricing, link to market prices, locational pricing



- Smart appliances, home automation networks
- Changed consumer behavior
- Distributed energy and storage
- Electric vehicles
- Social networking

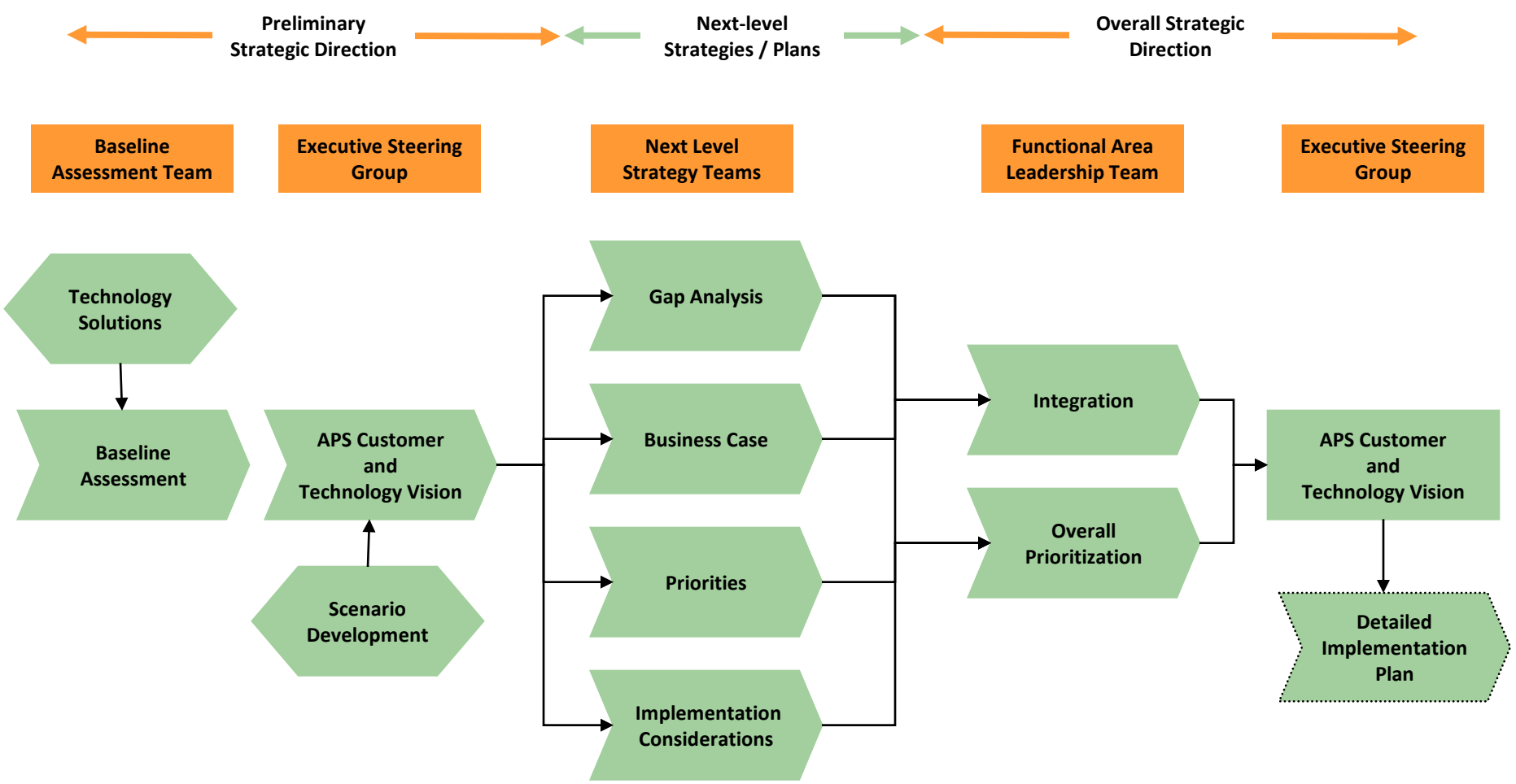
- Communications
- Sensor technologies
- Self-healing grid
- Efficient pricing
- Value added services

APS Customer and Technology 2020 Initiative

Objectives

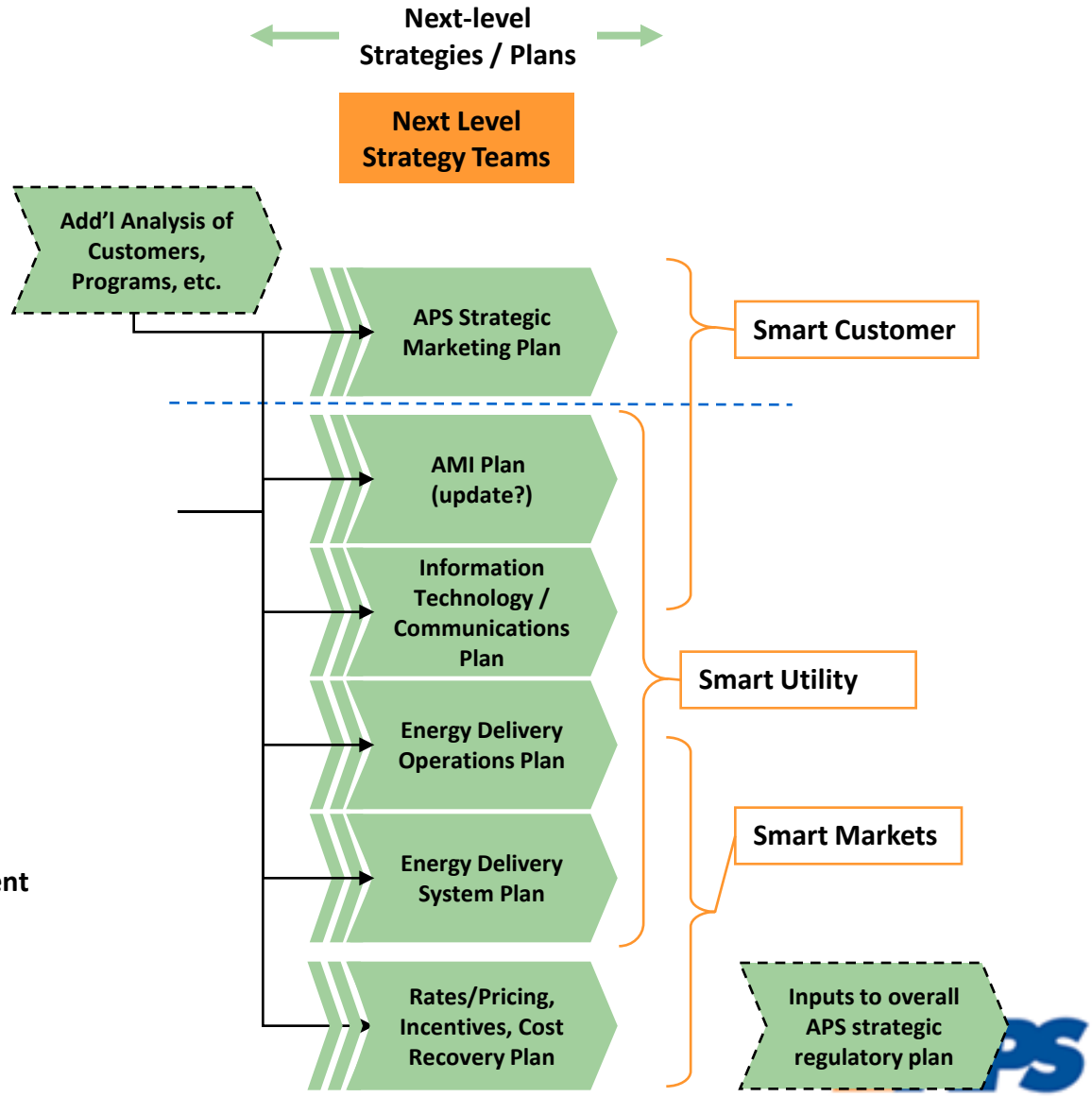
- Develop an overall Customer and Technology Vision for APS incorporating:
  - An overall long-term smart grid road map
  - An APS strategic marketing plan
- Address all major components necessary for success including:
  - Business case
  - Regulatory strategy
  - Implementation plan

Overall Process for the APS Customer and Technology 2020 Initiative



Next-level Strategy Teams

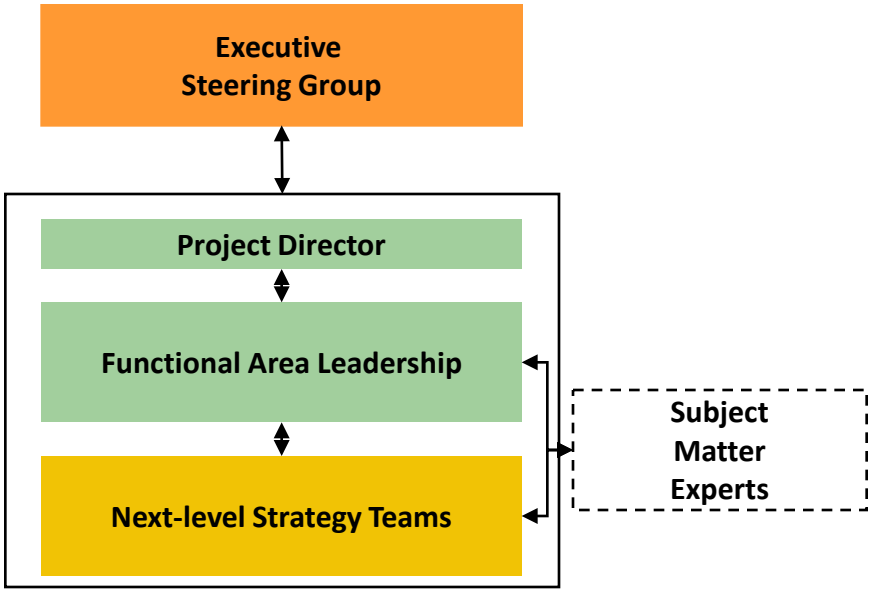
- Marketing
- AMI/Data Management
- IT/Communications
- Energy Delivery Operations
- Energy Delivery Asset Management
- Regulatory/Markets



APS Customer and Technology Vision - Teams

The Executive Steering Group would also preside over next-level Strategic Plans

The Project Director would manage all next-level Strategic Plans except for the Marketing Plan initiative which would be managed by Terry Orlick



Executive Steering Group	Functional Area Leadership		Next-level Strategy Teams
Wheeler (Executive Sponsor)	Lockwood (Project Dir.)	Moore	Marketing – Orlick
Albert	Atwell	Orlick	ED System Plan – R. Smith
Bohlen	Glock	Smith, R.	Ed Operations Plan – Glock
Dinkel	Goguen	Smith, J.	AMI / Data Mgmt – Goguen
Froetscher	Housley	Snook	IT / Communications – Housley
Guldner	Mahrer	Summerville	Regulatory – Snook
Lockwood	McElmury	Wilde	
McLeod			

Business Plan Update

Baseline Assessment Phase

Baseline Study

RW Beck to conduct an assessment of the current situation related to smart grid in North American utility markets

Key Questions to be addressed by the Study

- What are other utilities currently doing related to implementing smart grid? What have these utilities outlined as their future direction for smart grid?
- What are the key technologies associated with smart grid? What is the current and near-term, future direction associated with these key smart grid technologies?
- How does APS' smart grid and related technologies "map" vis-à-vis what others?

IS Architecture Assessment

- Completed framework
- Currently validating with business
- Working on incorporation into project planning

Customer Baseline Assessment

- Completed compilation of existing research (internal and external)
- Considering commissioning additional APS-specific research

Challenges to Smart Grid Deployment

- Evolving customer expectations, needs and desires
- Identifying and driving highest value efforts
- Obtaining clear and consistent regulatory policy and support
- Developing standards and protocols
- Immature technology markets
- Assuring system and cyber security

5 Things to Know About Smart Grid

1. There's not a single "smart grid" – it's a portfolio of technologies
2. It will be a long-term transformation: 10-20+ years
3. Success requires clear and consistent policy and regulatory support
4. There is significant opportunity to improve system reliability and efficiency
5. New customer products and services will change our business

Agenda

Smart Grid Overview	Lockwood	20 minutes
Flagstaff Pilot Project	**Rainey**	**20 minutes**
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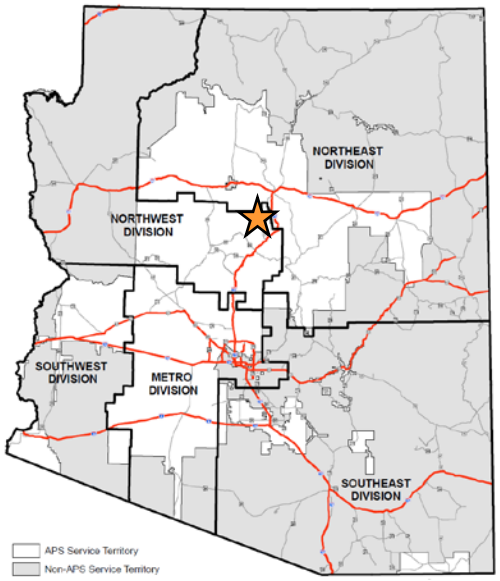
Flagstaff Smart Grid Pilot – What is it?

- Flagstaff Pilot leverages existing deployment of AMI and Distribution Operations and Maintenance System (DOMS)
- Smart Grid research opportunities
  - Safe deployment of “self-healing” technology
  - Evaluate concentrated DG in Community Power Project
  - Assess ability to reduce asset and operating costs
- Model for use elsewhere



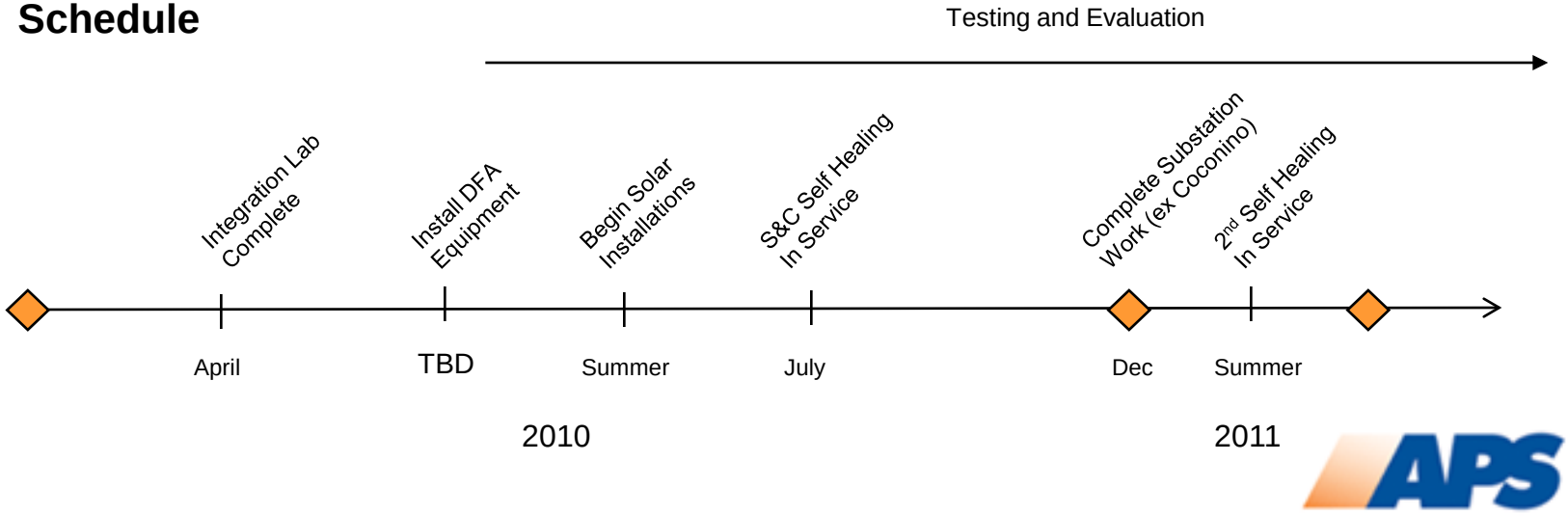
Flagstaff Smart Grid Pilot – Key Facts

- 95% of Flagstaff plus portions of Coconino County
- 35,000 AMI meters installed by August 31, 2009
- Automating feeder mid-points and tie-points
  - 15 distribution feeders out of 4 Flagstaff substations
- Sensoring technologies
  - Power outages
  - Fault indications
- Adopting “self-healing” technologies on 4 feeders
- “Large Pipe” fiber communications
- Design, test IS back office systems and protocols
- Budget: $39 million

Self-Healing Distribution

- Utilize 4 distribution feeders to analyze 2 vendor's self-healing technology.
- Each will isolate faults with automated switches and reroute power to another source to minimize the # of customers affected by the outage, or "self-heal"
- The technology analyzes load on new source feeder and sub station transformer to ensure that overloading does not occur
- Remaining feeders will receive automated switches that are controlled from the operations center
- Training is currently underway and preliminary work will begin as soon as weather conditions permit
- Target date for first 2 feeders to be commissioned with self-healing is July 1st

Schedule



Self-Healing Distribution (continued)

- Target date for next vendor self-healing technology is summer 2011
- May consider other technologies
- Pilot will help APS determine protocol for self-healing system wide

- Volt/Var
  - APS will analyze technology to improve volt/var in conjunction with self-healing.
  - Test pilot to begin in 2011

- Success Criteria
  - Improved # of outages
  - Improved Length of outages
  - Improved customer satisfaction

Community Power Project

- Located on one distribution feeder
- Opportunity to study a concentrated deployment of solar energy
- Incorporates 200 – 300 solar systems on eligible customer homes and businesses
- APS will install, operate and maintain systems
- Participants will be billed on the Community Power rate, which is fixed for 20 years
- Helps meet regulatory requirement for distributed energy
- Total of 1.5 – 2MW of distributed solar energy
- Includes 1MW of central storage – likely batteries

Community Power Project (continued)

- Solar Water Heaters
  - Installation of about 50 solar water heaters
  - For limited income customers

- Wind Power
  - Test small scale wind turbines
  - Work in conjunction with Northern Arizona University to analyze energy output
  - Work to improve ways to locate turbines for greatest gains

Community Power Project – Everyone Benefits

- Renewable benefits without investment obstacle
- No customer maintenance
- Avoid upfront costs
- Control energy costs

- Capitalizes on our most abundant resource
- Supports solar development
- Showcases sustainable technology
- Invests in our communities

- Delivers on regulatory obligations
- Value-added customer options
- Research new technology and consumer behavior
- Investments in sustainable assets

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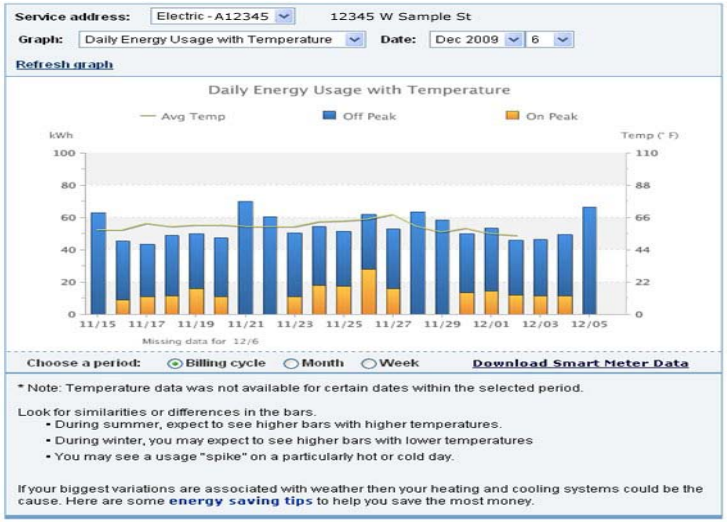
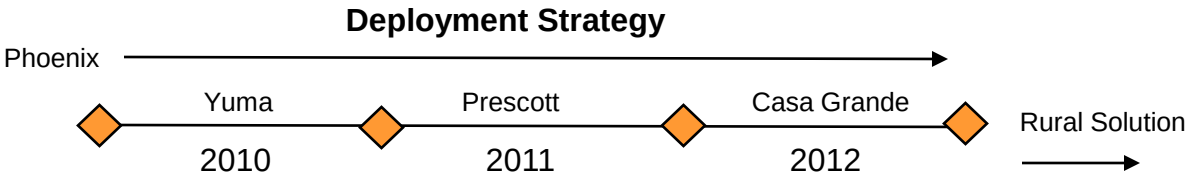
AMI Update

- Deployment of 1,000,000 “Smart Meters” by 2012
  - $220 M total investment
- 375, 000 deployed to date in metro Phoenix and Flagstaff
- Current capabilities
  - Remote meter reading, connect/disconnect and rate changes
    - 14,000+ field orders avoided per month
  - Greater customer information through aps.com
  - Support new rates (e.g. CPP, Super Peak, Pre-paid)
- 2010 Initiatives
  - In Home Display and Demand Response Pilot
  - Outage Order Creation
  - Energy Theft Mitigation
  - Pre-paid rate option
  - Enhanced System Security
  - Billing Quality Data for Interval Reads

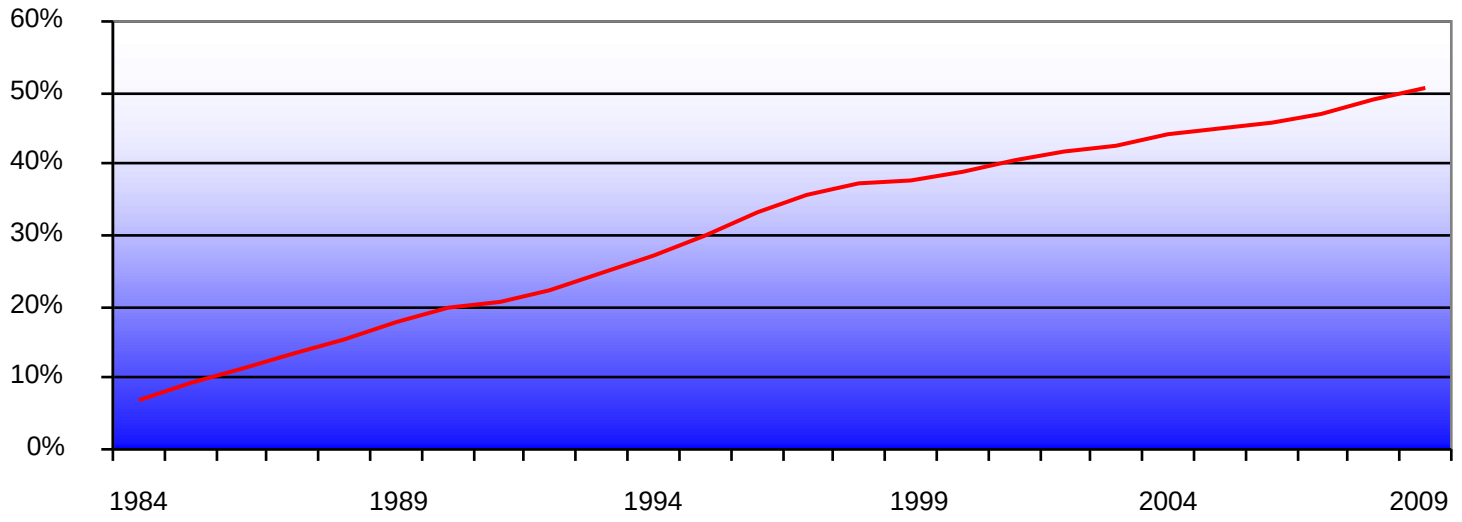




Customer Rate Options

- Initial experimental TOU rate implemented in 1976
- First widely available Residential TOU rates in 1982
- Over 500,000 Residential customers now on a TOU rate plan (leads the nation, 50% of cust)
- New Super Peak and Critical Peak rates available in January 2010

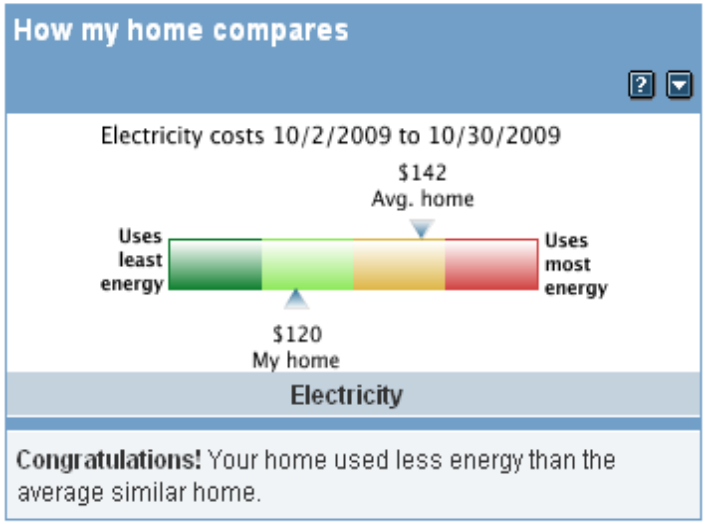
Historical Residential TOU Penetration

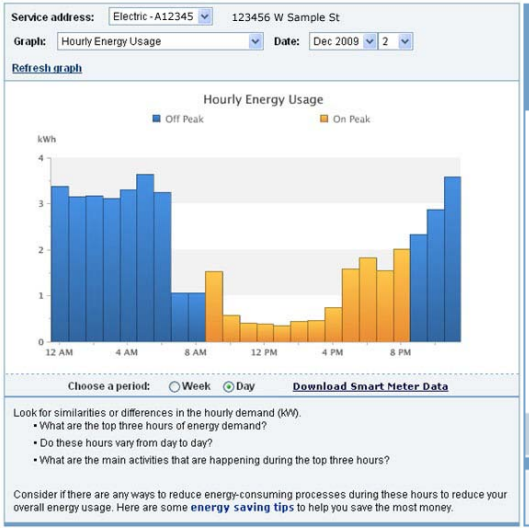


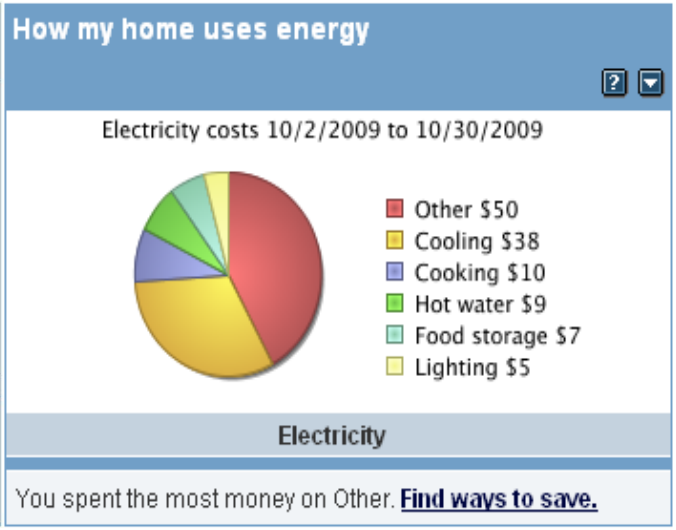
Bill Prism

- Account Summary
- Comparison to similar homes
- End-use appliance breakdown
- Usage comparison to prior periods
- Details on cost impacts of factors affecting bill

- Daily energy usage graph
  - Temperature overlay
  - Average energy usage overlay
- Average usage by day of week (on/off peak)
- Hourly energy usage (by week or day)
- Hourly demand (by week or day)





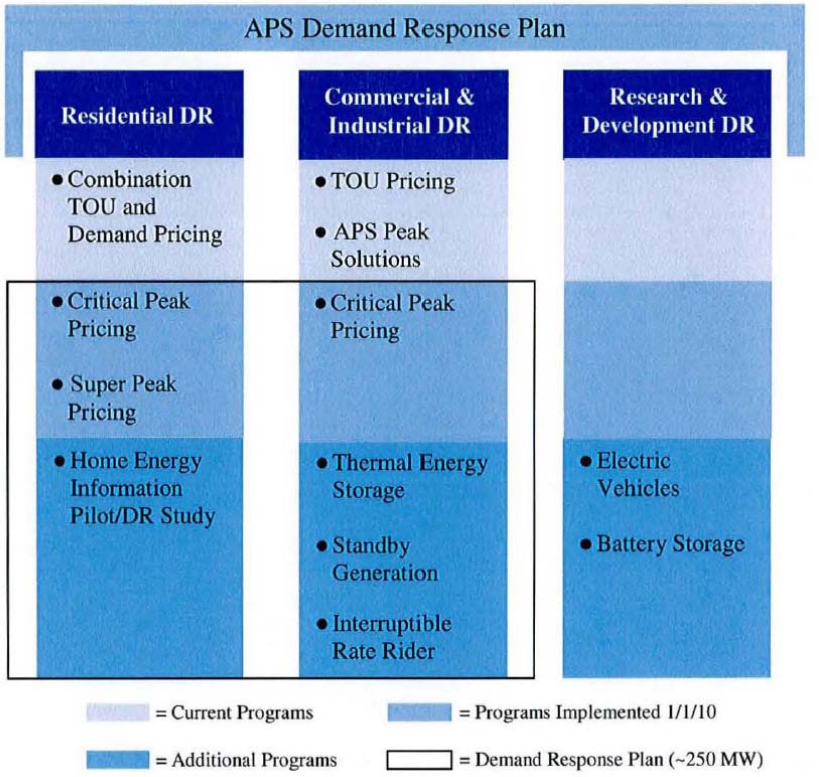


Demand Response

Comprehensive 250 MW Plan

- Filed with ACC on March 1, 2010
- Incorporates residential and commercial programs
- Progressive implementation

Targeted Customer Class	Demand Response Program	MW Reduction
Residential	Residential Direct Load Control	100 – 150 MW
	Residential Critical Peak Pricing	2 – 3 MW
	Residential Super Peak Pricing	1 – 2 MW
General Service	C&I Critical Peak Pricing	30 – 40 MW
	Interruptible Rate Rider	
	Thermal Energy Storage	2 – 15 MW
	Standby Generation	50 – 100 MW
	TOTAL MW REDUCTION	**185 – 310 MW**



Demand Response and the Smart Customer

Home Energy Information Pilot (Residential)

- Included in March 1 filing with ACC
- Incorporates in-home displays, demand response, and pre-paid energy service
- Targeting 200 customers in each test group:
  - Critical Peak Pricing with Enabling Technology
  - In-Home Displays
  - Direct Load Control
  - Smart Phone & PC App
  - Pre-Pay Energy Service (up to 2,000 customers)
- Small scale technology and consumer behavior assessment
- RFP in-development

APS Peak Solutions (Non-Residential)

- Contract signed with Comverge on July, 13, 2009
- Phoenix and Yuma – 100 MWs over 3 years (by 2012)
- June – September (Noon – 8:00pm); 1 – 6 hours/event
- Began customer enrollment on October 1, 2009
- Over 430 customers enrolled > 22 MWs

Electric Vehicles

- History of involvement with EVs (GM EV1)
- Electric Vehicle (V2G) study completed in March 2010
- April 2, 2010 ACC filing of study and program
- Nissan LEAF / eTec deployment in Arizona
  - One of five states / 11 major markets
  - ~ 500 - 700 cars in Phoenix area by EOY
- Internal effort to define EV business model for APS (system impacts, rates, meters, 3rd party, ownership, incentives, etc.)
- Target APS EV Program filing Q3, 2010

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