Welcome and Recap of 2010 Meetings

Jim Wilde – Director, Resource Planning
## Agenda

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Presenter/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00 – 9:45</td>
<td>Welcome and Recap</td>
<td>Jim Wilde - Director, Resource Planning</td>
</tr>
<tr>
<td>9:45 – 10:30</td>
<td>Planning Considerations for 2012</td>
<td>Jim Wilde - Director, Resource Planning</td>
</tr>
<tr>
<td>10:30 – 10:45</td>
<td>Break</td>
<td></td>
</tr>
<tr>
<td>10:45 – 11:30</td>
<td>Assumptions, Portfolios &amp; Sensitivity Analysis</td>
<td>Paul Smith - Manager, Resource Analysis</td>
</tr>
<tr>
<td>11:30 – 1:00</td>
<td>Lunch</td>
<td></td>
</tr>
<tr>
<td>1:00 – 1:45</td>
<td>Informed Perception Highlights</td>
<td>Mike Overson – Sr. Research Analyst</td>
</tr>
<tr>
<td>1:45 – 3:00</td>
<td>Resource Programs</td>
<td></td>
</tr>
<tr>
<td>3:00 – 3:15</td>
<td>Break</td>
<td></td>
</tr>
<tr>
<td>3:15 – 3:45</td>
<td>Water Planning Update</td>
<td></td>
</tr>
<tr>
<td>3:45 – 5:00</td>
<td>Other Presenters / Open Discussion</td>
<td></td>
</tr>
</tbody>
</table>

### Additional Information

www.aps.com/resources
APS Resource Planning - Overview

Objective
Develop a long-term strategy aimed at meeting future customer needs, achieving regulatory targets and managing environmental impacts, all at a reasonable cost

Analytical Framework
• Reliability
• Risk
• Environment
• Customer Cost

Portfolio Analysis
Evaluate a variety of portfolios to determine which combination of resources will be selected as the Resource Plan

Sensitivity Analysis
Consider how various resource portfolio combinations would perform under certain future conditions
Regulatory Timeline

- **April 2010**: APS initiates series of Resource Planning Stakeholder Meetings for 2011 IRP
- **June 2010**: ACC adopts Resource Planning and Procurement Rules (Decision No. 71722)
- **October 2010**: AG certifies Resource Planning and Procurement Rules
- **March 2011**: ACC waives requirement to file 2011 IRP
- **April 2011**: 2011 IRP due date
- **August 2011**: APS holds Stakeholder Meeting for 2012 IRP
- **April 2012**: 2012 IRP is due
Recap of 2010 Stakeholder Meetings

Four Meetings – Many Topics

Meeting #1
April 20
• APS Existing Resources
• APS Existing Transmission
• Climate Change and Resource Planning

Meeting #2
May 07
• Peak Demand and Energy
• Demand-Side Management, Near Term
• Energy Efficiency
• Initiatives Overview: Smart Grid Electric Vehicles, Energy Storage and Demand Response
• Portfolios and Sensitivities

Meeting #3
May 28
• APS Fossil Fuel Supply and Hedging
• Water Use for Power Production
• Valuing Water in Electric Resource Planning
• New Resources Technologies and Costs

Meeting #4
June 18
• Financial Considerations of APS’s Resource Plan
• Accounting for Human Health Externalities
• Competitive Alternatives
• Resource Procurement
Meeting #1 - Highlights

**APS Existing Resources**

**Outlook for Palo Verde (nuclear)**
- APS’s largest base load generator
- Low, relatively stable operating cost
  - Long-term fuel contracts
  - No carbon costs
  - Effluent water supply contracted through 2050

**Outlook for Existing Coal Plants**
- Stably-priced, base load power
- Hedge against natural gas price volatility
- Coal plants are sensitive to CO2 legislation
- California participants likely to exit from Four Corners 4-5 (SCE), and Navajo 1-2-3 (LADWP) per California SB 1368

**Outlook for Existing Gas Plants**
- West Phoenix and Ocotillo units provide reliability to the Phoenix Metro Area
- Yucca units provide capacity and reliability to the Yuma area

---

**Over 6,000 MW needed by 2025**

- **Existing Owned Resources**
- **Existing Contracts**
- **New Resource Requirement**

---

**APS Existing Resources**

- **Existing Owned Resources**
- **Existing Contracts**
- **New Resource Requirement**

- **MW**
  - 0
  - 2,000
  - 4,000
  - 6,000
  - 8,000
  - 10,000
  - 12,000
  - 14,000

- **Years**
  - 2011
  - 2018
  - 2025

---

7
Meeting #1 – Highlights (cont’d)

Climate Change and Resource Planning

Impact of Assumed Carbon Price on APS Customers
• At 20 $/ton, CO2 emissions could cost APS customers up to $320 million per year
• At 50 $/ton, CO2 emissions could cost APS customers up to $800 million per year

Treatment of Carbon in Resource Planning
• Carbon pricing not included in previous resource plans. However, in sensitivity analyses, APS assumed carbon prices points of 20 $/ton and 50 $/ton, and performed further sensitivity analyses on additional pricing points
Meeting #2 - Highlights

**Forecasted Demand and Energy**

- **Recession**
  - Capacity growth has slowed from 350 to < 100 MWs / year

- **Energy efficiency**
  - Eliminating half of the near-term energy growth

- **Distributed energy**
  - 4,000 installations annually 2011 – 2016
### Demand-Side Management

**Energy Efficiency**
- ACC EE Standard: 22% by 2020
- Saving kWh throughout the day/month/year
- Not just targeted to peak hours
- Savings not necessarily the same in all hours, depending on load shape of measure installed

**Demand Response**
Saving kWh in targeted peak hours of summer afternoons when demand for electricity is at its highest

### Initiatives Overview

**Smart Grid**
- Deployment of 1,000,000 “Smart Meters” by 2012
- Flagstaff Smart Grid Project

**Energy Storage**
Energy Storage Demonstration Project underway for both utility and commercial scale

**Demand Response Programs**
- APS Peak Solutions
- HEI Pilot Program
Portfolios & Sensitivities

**Portfolio**
- Set of resources included in a plan designed to reliably meet APS total load requirements
- Includes existing generation, power purchases, new renewable generation (distributed and utility scale), energy efficiency, and new conventional generation, etc.

**Sensitivity Studies**
- Change the value of a single key variable at a time to determine the impact on results
- Does not attempt to “tell a story”, or vary groups of variables whose values may be correlated

Sensitivities

- Carbon Prices
- Natural Gas Prices
- Technology Costs
- Tax Credits

Key Metrics

- Customer Cost
- Natural Gas Burn
- Carbon Emissions
- Capital Requirements
- Water Consumption
New gas supplies are expected to be directed into the region:

- At present, gas prices have become significantly uncorrelated from oil prices in North America compared to historical trends.
- Gas from the Rockies will be increasingly directed toward the West as it is displaced from eastern and southern shale plays.
- Timing, magnitude, and impact of any future regulations are uncertain.
Meeting #3 – Highlights (cont’d)

Valuing Water in Resource Planning

• Value of water may be higher than current prices paid
• Prices rise with population growth and droughts
• Colorado River Basin is already over-allocated and fully used
• Cooling technologies and RE / EE Standards will mitigate effects of water price increases

* Includes treatment costs
Meeting #4 – Highlights

Financing

• Several paths to finance a generation project

• Need to raise all tranches of capital for project to succeed

• The simpler the better
  – Financing structures can get complicated especially around tax equity
  – More complex, more need for financing contingency plans to keep project on-time

• Access to capital critical
  – Developers experienced in financing projects
  – APS’s ability to fund from investment grade corporate balance sheet is critical

Resource Procurement

APS Project Evaluation Criteria

• Quantitative
  – Pricing shall be fixed and inclusive of all delivery costs and necessary credit support
  – Additional costs (imputed debt, APS transmission upgrade costs, etc.)
  – Cost of comparable conventional generation

• Qualitative
  – Financial statement & project financing review
  – APS development security
  – Developer experience, project viability & status
  – Technology
  – Consideration of proposed contract modifications
NAS Study - Coal Plants Relative to APS Plants

406 Coal Plants
Average Estimated Externality Costs / MWh

$107.00

$42.45

$21.99

$8.84

Top 100 101 - 200 201 - 300 300 - 406

APS coal plants have significantly lower NAS cost estimates than the vast majority included in the NAS Study.

Source: National Academy of Sciences

Total estimated externality costs per MWh for APS Coal plants in NAS Study

Four Corners $5.91
Cholla* $4.37
Navajo $3.19

* Updated to reflect current environmental controls (does not include future)
Key Takeaways - Stakeholder Meetings for 2011

Resource Planning Objective
Develop a long-term strategy aimed at meeting future customer needs, achieving regulatory targets and managing environmental impacts at a reasonable cost

Resource Need
Over 6,000 MW needed by 2025

Climate Change and Resource Planning
Carbon pricing assumption now included

Decreased Reliance on Conventional Resources
Renewable energy and energy efficiency will play increasingly important roles in APS’s resource mix

Fossil Fuels
Shale gas expected to be a game-changer, but timing, magnitude, and impact of any future regulations are uncertain.

Valuing Water
Resource diversity and new technologies will mitigate effects of water price increases

Financing
Ability to fund from investment grade corporate balance sheet is critical

Externalities
NAS Study provides independent, peer-reviewed perspective
2012 Planning Considerations

Jim Wilde – Director, Resource Planning
Resource Planning and Procurement Rules

• **Purpose**
  – Establish framework and process for dialogue regarding the need for new energy resources and associated risks
  – Provide for Commission acknowledgement of utility resource plan

• **Requirement**
  – File 15-year resource plan by April 1st of every even year

• **Evaluation Criteria for Plan**
  – Resource diversity
  – Reliability
  – Flexibility
  – Cost-effectiveness
  – Assessment of environmental impacts
  – Consider broad spectrum of risks
  – In best interest of customers
Resource Planning Process

Develop Scope
- What do we need?
- When do we need it?
- Technical and program data

Gather Input
- Stakeholder meetings
- Internal collaboration
- Rules, regulations and standards

Formulate Risk Management Framework
- Evaluation Criteria Considered
  - Resource diversity, reliability, intermittency
  - Environmental impacts
  - Cost projections
  - Fuel price volatility

Establish Plan Inputs
- Update/analyze resource cost information
- Assess potential new regulations
- Select resource portfolio alternatives

Evaluate Alternative Portfolios
- Assess portfolios across broad spectrum of considerations
- Perform sensitivity analyses to test if portfolios are robust under various conditions

Select
- Select balanced mix of resources
- Ensure selection is sufficiently flexible
- Consider trade-offs
Analytical Framework

Reliability
- Generation
- Transmission
- Regulatory standards

Cost
- Capital investment
- Customer cost
- Technology costs

Risk
- Program costs
- Fuel markets
- Technology costs
- Permitting/licensing
- Tax credits

Environmental
- Water consumption
- Externalities
- Carbon
- Regulations
Current Landscape

Economy
- Improving, but slowly and unevenly

Revised Forecast
- Growth not expected to resume until 2014

Regulatory
- EPA regulations are being evaluated

Legislative
- Future of tax credits is uncertain

Climate Change
- Future of carbon legislation is uncertain
## Loads and Resources

All figures shown in MW\(^{1}\)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Load Requirements(^2)</strong></td>
<td>8,151</td>
<td>9,088</td>
<td>10,817</td>
<td>12,486</td>
<td></td>
</tr>
<tr>
<td><strong>Existing Resources(^3)</strong></td>
<td>8,603</td>
<td>8,621</td>
<td>7,061</td>
<td>6,316</td>
<td>-2,287</td>
</tr>
<tr>
<td>Energy Efficiency</td>
<td>69</td>
<td>499</td>
<td>1,126</td>
<td>1,339</td>
<td>1,270</td>
</tr>
<tr>
<td>Distributed Renewable Energy</td>
<td>45</td>
<td>144</td>
<td>212</td>
<td>335</td>
<td>290</td>
</tr>
<tr>
<td>Utility-Scale Renewable Energy Resources</td>
<td>11</td>
<td>490</td>
<td>489</td>
<td>967</td>
<td>956</td>
</tr>
<tr>
<td>Natural Gas / Demand Response</td>
<td>0</td>
<td>30</td>
<td>1,750</td>
<td>3,350</td>
<td>3,350</td>
</tr>
<tr>
<td>Coal (Proposed Four Corners Transaction)</td>
<td>0</td>
<td>179</td>
<td>179</td>
<td>179</td>
<td>179</td>
</tr>
<tr>
<td><strong>Future Resource Additions(^4)</strong></td>
<td>125</td>
<td>1,342</td>
<td>3,756</td>
<td>6,170</td>
<td>6,045</td>
</tr>
<tr>
<td><strong>Total Resources</strong></td>
<td>8,728</td>
<td>9,963</td>
<td>10,817</td>
<td>12,486</td>
<td>3,758</td>
</tr>
</tbody>
</table>

**NOTES:**

1. Resources shown as expected capacity at time of system peak. Energy efficiency modeling consistent with Energy Efficiency Standard.
2. Including reserve requirements.
3. The net reduction in Existing Resources is due to expiring contracts of 2,287 MW.
4. Future Resource Additions include net 179 MW of capacity from Proposed Four Corners Transaction assumed for analysis purposes 2012.
Select Assumptions and Considerations

- Energy efficiency standard 22% by 2020
- Renewable energy standard 15% by 2025, of which Distributed Energy must be at least 30%
- New nuclear being evaluated but not anticipated in current 15 year planning horizon due to deferral of baseload energy needs
- Carbon legislation
- Environmental impacts and externalities
- Cooling technology on newly constructed generation
New Resource Costs

$50
$100
$150
$200
$250
$300

$MWh

Existing plants
Energy efficiency
Natural gas-CC
Wind
Solar-PV
Geothermal
Coal
Nuclear
Solar-thermal
# Capacity Growth Components

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• 1,270 MW</td>
<td>• 1,500 MW</td>
<td>• 1,000 MW</td>
<td>• 300 MW</td>
</tr>
<tr>
<td>• Meets 40% of energy growth during planning period</td>
<td>• Meets 33% of energy growth during planning period</td>
<td>• Meets 10% of energy growth during planning period</td>
<td></td>
</tr>
</tbody>
</table>

## Cost

<table>
<thead>
<tr>
<th>Resource Addition</th>
<th>Cost</th>
<th>Cost</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Financial incentives are necessary</td>
<td>• High cost to build</td>
<td>• High cost to build</td>
</tr>
<tr>
<td></td>
<td>• Currently low cost, future costs expected to rise</td>
<td>• Low cost to operate</td>
<td>• Low cost to operate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Requires back-up capacity</td>
<td>• Requires back-up capacity</td>
</tr>
</tbody>
</table>

## Availability

<table>
<thead>
<tr>
<th>Resource Addition</th>
<th>Availability</th>
<th>Availability</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Customer participation dependent</td>
<td>• Day-time</td>
<td>• Day-time, intermittent</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Intermittent for solar and wind</td>
<td>• Customer participation dependent</td>
</tr>
</tbody>
</table>

## Environment

<table>
<thead>
<tr>
<th>Resource Addition</th>
<th>Environment</th>
<th>Environment</th>
<th>Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• No emissions</td>
<td>• No emissions</td>
<td>• No emissions</td>
</tr>
<tr>
<td></td>
<td>• No water usage</td>
<td>• Some water usage</td>
<td>• No water usage</td>
</tr>
</tbody>
</table>
Capacity Growth Components (cont.)

<table>
<thead>
<tr>
<th>Resource Addition</th>
<th>MW Growth</th>
<th>Natural Gas</th>
<th>MW Growth</th>
<th>Coal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demand Response</strong></td>
<td>500</td>
<td>4,000</td>
<td>1,000</td>
<td></td>
</tr>
<tr>
<td>Demand</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Response</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Natural Gas</strong></td>
<td>2,905</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resource Addition</td>
<td>445 MW</td>
<td>2,905 MW</td>
<td>179 MW</td>
<td></td>
</tr>
<tr>
<td>• Includes 250 MW from ACC Decision No. 71448</td>
<td>• Meets 17% of energy growth during Planning Period</td>
<td>• Assumes approval of Proposed Four Corners transaction</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cost</strong></td>
<td>Low cost to develop</td>
<td>Low cost to operate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Defers construction of new peaking resources</td>
<td>Uncertain fuel prices</td>
<td>Costs likely to increase with regulations</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Availability</strong></td>
<td>Abundant, reliable</td>
<td>Abundant, reliable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limited availability</td>
<td>Enables integration of intermittent resources</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customer participation dependent</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Environment</strong></td>
<td>No emissions</td>
<td>Reduced emissions</td>
<td>Higher emissions</td>
<td></td>
</tr>
<tr>
<td>No water usage</td>
<td>Reduced water usage</td>
<td>Higher water usage</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- 445 MW
- Includes 250 MW from ACC Decision No. 71448
- 2,905 MW
- Meets 17% of energy growth during Planning Period
- 179 MW
- Assumes approval of Proposed Four Corners transaction
- Defers construction of new peaking resources
- Low cost to develop
- Uncertain fuel prices
- Low cost to operate
- Costs likely to increase with regulations
- Abundant, reliable
- Enables integration of intermittent resources
- Abundant, reliable
- No emissions
- No water usage
- Reduced emissions
- Reduced water usage
- Higher emissions
- Higher water usage
Capacity Mix

- APS anticipates adding over 2,500 MW of renewable generation and energy efficiency capacity by 2025.
- Natural gas capacity additions enable integration of renewable energy while meeting peaking requirements.
- Proposed Four Corners transaction maintains stably-priced coal resources.

<table>
<thead>
<tr>
<th>Year</th>
<th>Renewal Energy</th>
<th>Demand Response</th>
<th>Nuclear</th>
<th>Coal</th>
<th>Natural Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>1,339</td>
<td>59</td>
<td>1,146</td>
<td>1,753</td>
<td>6,273</td>
</tr>
<tr>
<td>2025</td>
<td>1,352</td>
<td>445</td>
<td>1,146</td>
<td>1,932</td>
<td>5,578</td>
</tr>
</tbody>
</table>
Resource Diversity

Maintain core nuclear and coal generation while advancing new technologies enabled by natural gas.

2011
Total Energy
32,606 GWh

2025
Total Energy
48,207 GWh

Customer energy growth of 15,600 GWh, nearly 50% above current levels.
Meeting Energy Growth

- Over 80% of our energy growth for the 15 year planning horizon is anticipated to be met by
  - Renewable Energy
  - Energy Efficiency

- Natural gas generation enables integration of renewable resources while meeting peaking requirements

- More reliance on customer program participation

- Consistent with energy efficiency and renewable energy standards

### APS Energy Growth Sources 2011 - 2025

- **33%** Utility-Scale Renewable Energy
- **10%** Distributed Energy
- **40%** Energy Efficiency
- **17%** Natural Gas
Next Steps

• Develop portfolios considering:
  – Energy efficiency and renewable energy
  – Resource contingencies
  – Environmental impacts
  – Cost of new technologies

• Consider input from Stakeholder Meeting

• File resource plan by April 1st, 2012
Assumptions, Portfolios and Sensitivities

Paul Smith, Manager – Resource Analysis
Outline

• Key Assumptions
  – Natural Gas
  – Carbon
  – Water
  – Solar PV

• Resource Portfolios

• Sensitivities
Natural Gas Prices

6/30/2011 Market
9/30/2010 Market
6/30/2011 Market Stressed 30% Higher
6/30/2011 Market Stressed 30% Lower

$/MMBTU

Carbon Prices

$ Price per Ton


9/30/2010 Assumption

6/30/2011 Assumption?

$0 $5 $10 $15 $20 $25 $30 $35
Water Prices

$ per Acre Foot

6/30/2011 Assumption

*Includes treatment costs
Capacity Values

<table>
<thead>
<tr>
<th>Today</th>
<th>PV Capacity Values in 2025</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thin-Film Solar PV – Single Axis</td>
<td></td>
</tr>
<tr>
<td>70%</td>
<td>The CV quickly declines...</td>
</tr>
<tr>
<td>CSP, Hybrid-cooled, 6 hrs storage</td>
<td>with the first 900 MW</td>
</tr>
<tr>
<td></td>
<td>(10% of load), the CV drops to</td>
</tr>
<tr>
<td>Wind</td>
<td>26%</td>
</tr>
<tr>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>Geothermal</td>
<td></td>
</tr>
<tr>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Biomass / Biogas</td>
<td></td>
</tr>
<tr>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

The CV quickly declines... with the first 900 MW (10% of load), the CV drops to 26%

If the current RES (15% by 2025) is met w/ only PV that would equate to 2,400 MW of PV, of that only 320 MW contributes to meet peak needs

Bottom line: we would need 2,080 MW of CTs for reliability requirements
Portfolios & Sensitivities

• Portfolio
  – Set of resources included in a plan designed to reliably meet APS total load requirements
  – Includes existing generation, power purchases, new renewable generation (distributed and utility scale), energy efficiency, and new conventional generation, etc.

• Sensitivity Studies
  – Change the value of a single key variable at a time to determine the impact on results
  – Does not attempt to “tell a story”, or vary groups of variables whose values may be correlated
Goals of Portfolio Analysis

- Resource diversity
  - Balanced mix of resources
- Reliability
  - Adequacy in meeting peak conditions
- Environment
  - Consideration of impacts
- Customer cost
  - Affordability of service
- Risk management
  - Consideration of broad spectrum of risks
Considerations for 2012 Resource Plan

Portfolios
- Natural Gas
- 4-C Contingency
- Carbon Cap (coal)
- Renewables
- Other?

Sensitivities
- Carbon Prices
- Externalities
- Technology Costs
- Natural Gas Prices
- Tax Credits

Key Metrics
- Reliability
- Carbon Emissions
- Natural Gas Burn
- Customer Cost
- Water Consumption
- Capital Requirements
Key Metrics Dash Board

Energy Mix (2027 GWH)

- Portfolio 1: 12% Nuclear, 4% Coal, 23% Natural Gas, 19% Energy Efficiency, 19% Distributed Energy, 19% Non DE Renewable Sources
- Portfolio 2: 20% Nuclear, 4% Coal, 24% Natural Gas, 19% Energy Efficiency, 19% Distributed Energy, 19% Non DE Renewable Sources
- Portfolio 3: 12% Nuclear, 4% Coal, 12% Natural Gas, 12% Energy Efficiency, 12% Distributed Energy, 12% Non DE Renewable Sources
- Portfolio 4: 12% Nuclear, 4% Coal, 12% Natural Gas, 12% Energy Efficiency, 12% Distributed Energy, 12% Non DE Renewable Sources

Natural Gas Burn in 2027

- Portfolio 1: 4% (Billion Cubic Feet (BCF))
- Portfolio 2: 4% (BCF)
- Portfolio 3: 4% (BCF)
- Portfolio 4: 16% (BCF)

CO2 Emissions in 2027

- Portfolio 1: 16 Billion Metric Tons
- Portfolio 2: 16 Billion Metric Tons
- Portfolio 3: 16 Billion Metric Tons
- Portfolio 4: 16 Billion Metric Tons

Cumulative Capital Expenditures

- Portfolio 1: $12 Billion
- Portfolio 2: $12 Billion
- Portfolio 3: $12 Billion
- Portfolio 4: $12 Billion
Sensitivities: Impact on Customer Cost

Carbon Price Sensitivity Impact

<table>
<thead>
<tr>
<th>Port 1</th>
<th>Port 2</th>
<th>Port 3</th>
<th>Port 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Natural Gas Sensitivity Impact

<table>
<thead>
<tr>
<th>Port 1</th>
<th>Port 2</th>
<th>Port 3</th>
<th>Port 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Examples shown are illustrative
Informed Perception

• Purpose: To understand customer energy resource preferences, specifically evaluating the effects of education.

• Morrison Institute recruited a 24-member Collaborative Committee to help assure accurate and balanced content.

• Randomly selected APS customers were recruited to receive educational information about energy resource options and participate in a day-long energy forum.
Energy Information

• The Collaborative Committee advised Morrison Institute in preparation of an educational booklet describing the primary resource options perceived to be available to APS.
  • Coal
  • Natural Gas
  • Nuclear
  • Hydro
  • Solar
  • Wind
  • Geothermal
  • Energy Efficiency

• Participants were asked to review the booklet prior to attending the Energy Forum.
The Energy Forum

- Large-group sessions with expert panelists answering questions posed by a moderator and by the audience.

- Small-group break-out sessions with professional moderators designed to facilitate discussion.

- Designed to clarify information and help participants develop their own opinion.
Four Surveys

- **Survey #1 (t1)** – used as a baseline for establishing demographic profile, attitudes toward resource options, and willingness to pay for priorities.
- **Survey #2 (t2)** – Immediately prior to Energy Forum.
- **Survey #3 (t3)** – Immediately after Energy Forum.
- **Survey #4 (t4)** – 30 days after Energy Forum.
**Resource Perceptions**

- Solar was perceived to do little harm to the environment.
- In the 1st survey, solar was viewed as the most dependable source. By the 2nd survey, solar was rated as the second least dependable, trailing only wind power.

- Wind is seen as a less harmful source of energy.
- Wind is perceived as relatively inexpensive (even though the written materials show wind as potentially more expensive due to intermittency).
Resource Perceptions

- Coal is perceived to be dependable, relatively inexpensive and environmentally harmful.
- While participants felt that APS should not build new coal plants, participants agreed that APS should continue using existing coal plants.

- Participants perceive natural gas as a less harmful, dependable energy source.
- Participants were concerned about natural gas price instability.
Resource Perceptions

Energy Efficiency Programs

- Perceived to be least harmful and least expensive option.
- Participants felt that APS needs to do more to educate people about Energy Efficiency.

- Highly dependable but very expensive, and moderately harmful.
- Participants revealed concerns regarding long-term waste storage.
Summary of Key Findings

Attribute Importance Over Four APS Surveys

(H) Renewable electricity  (B) Minimize air pollution  (I) Avoid outages on hot days  (G) Create jobs in AZ  (F) Reduce radioactive waste  (E) Reduce greenhouse gases  (A) Keep rates low  (C) Use power produced in AZ  (J) Generate own power  (D) Keep scenic beauty of AZ
Resource Program Planning & Emerging Technologies

Barbara Lockwood – Director Energy Innovation
Overview

• Resource Program Planning
  – Customer program role in meeting energy growth
  – Aspects of customer programs
  – Demand Response Update

• Emerging Technologies
  – Smart Grid
  – Energy Storage
  – Electric Vehicles
Meeting Future Energy Needs

50 percent of APS’s future energy resources anticipated to be customer sited
Planning for Resource Programs
Resource Program Planning

Market Monitoring
- Technologies and products
- Costs and pricing trends
- Standards and codes
- Customers and segments

Evaluation and Filters
- Program fit and cost
- Location and system benefits
- Technology/product synergies and interplay
- Portfolio design

Portfolio Design and Deployment
- Market and regulatory drivers
- Portfolio cost/benefits
- Customer and segment strategies
- Product/technology offers

- Product mix
- Deployment and adoption strategies
- Customer and segment fit
- Product/technology pairing
Resource Program Workplan

1. Benchmarking
   a. Evaluate baseline studies
   b. Gap identification and cross-linked technology/programs
   c. Update benchmarks to reflect current market and technologies

2. Advancing the Logic
   a. Value and opportunity based research
   b. System and value-based deployment

3. Building the roadmap
   a. Develop strategic resource program portfolio
   b. Define foundational considerations in achieving objective
Demand Response Update
Current Programs

Time-Of-Use
• 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 nation in both number and percentage of Residential customers
• New Super Peak and Critical Peak rates available in January 2010

APS Peak Solutions
• Demand Response program for Commercial & Industrial customers
• Approved by Commission in 2009
• 100 MW contract
  – Starting summer 2010, ramping to full capacity by 2012

Home Energy Information Pilot
• Two year pilot to study the most effective way to reduce consumption
  – In home displays
  – Smart thermostats
  – Smart phone apps
  – Pre-paid electricity
• Targeting both consumption and demand reduction
• Rigorous assessment of technology & consumer behavior
• Up to 2,800 customers
• Approved by Commission in February 2011
• Deployment in late-2011/12
## Demand Response
### Potential Program Mix

<table>
<thead>
<tr>
<th>Targeted Customer Class</th>
<th>Demand Response Program</th>
<th>MW Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>Residential Direct Load Control</td>
<td>100 – 150 MW</td>
</tr>
<tr>
<td></td>
<td>Residential Critical Peak Pricing</td>
<td>2 – 3 MW</td>
</tr>
<tr>
<td></td>
<td>Residential Super Peak Pricing</td>
<td>1 – 2 MW</td>
</tr>
<tr>
<td>General Service</td>
<td>C&amp;I Critical Peak Pricing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Interruptible Rate Rider</td>
<td>30 – 40 MW</td>
</tr>
<tr>
<td></td>
<td>Thermal Energy Storage</td>
<td>2 – 15 MW</td>
</tr>
<tr>
<td></td>
<td>Standby Generation</td>
<td>50 – 100 MW</td>
</tr>
<tr>
<td></td>
<td><strong>TOTAL MW REDUCTION</strong></td>
<td><strong>185 – 310 MW</strong></td>
</tr>
</tbody>
</table>

**Regulatory Overview**
- Required by Decision No. 71448
- Filed on March 1, 2010
- Accepted February 17, 2011
Smart Grid – Why?

The primary objectives of deploying a smarter grid are to:

- Optimize Reliability
- Empower Customers
- Enable Alternative Energy
The major launch of APS’ Smart Grid strategy occurred in 2006 with AMI ... followed by Flagstaff.
Smart Meters/AMI

- Deployment of ~1,000,000 “Smart Meters” by 2012
  - $220 million total investment

- Over ½ way completed with meters in Phoenix, Yuma, Flagstaff, and Prescott

- Remote meter reading, connect/disconnect, and rate change
  - Exceeded 600K field orders avoided to date

- Power outage notification

- Greater customer information and flexibility
Flagstaff Pilot

- 36,000 Smart Meters installed in 2009
- Automating system components for remote operations
- Monitoring technologies for power outages and system faults
- “Self-isolating” technologies
- High volume fiber communications
- Community Power Project
  - 1.3 MW Solar
  - Energy Storage

Sixteen activations of the self-isolating system have saved over 530,000 customer outage minutes within a year

Over 66% improvement in reliability

$4 million DOE stimulus grant to study high concentration of PV solar energy on the grid
Pioneer Pilot

Objectives:
1. Create a Smart Circuit (SC) pilot platform that will allow:
   - Distribution automation platform in a metro location
   - Demonstrate Volt/Var Optimization and Conservation Voltage Reduction
2. Leverage SC pilot to model Resource Program Management integration:
   - Cost effective methods of delivering integrated customer programs
   - Continue to assess integrated/cross program design
   - Comply with Commission Order (No. 72060)

Key Elements:
- Volt/Var Control – Conservation Voltage Reduction
- Self-Isolating Feeders – Centralized Control
- Enhanced Energy Audit (EE/DE/DR, screening tool, & web-portal)
- Energy Coach (Res & Non-Res)
- APS owned inverter offering with Home Energy Management (“auto-DR”)
**Smart Grid Technology Deployment Matrix**

This matrix is not intended to portray specific commitments to projects or programs but illustrative of near term and long term potential.

<table>
<thead>
<tr>
<th>Technology</th>
<th>Pilot</th>
<th>Deploy</th>
<th>Near Term Deployment (1-3 years)</th>
<th>Long Term Potential (&gt;3 years)</th>
<th>Geographic Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMI</td>
<td></td>
<td>✓</td>
<td>&gt; 1 million</td>
<td>AMI 2.0</td>
<td>All</td>
</tr>
<tr>
<td>Distribution Automation</td>
<td>✓</td>
<td></td>
<td>50 devices</td>
<td>20% of feeders 200 – 400 devices</td>
<td></td>
</tr>
<tr>
<td>Self-Isolating</td>
<td>✓</td>
<td></td>
<td>50 devices</td>
<td>10% of feeders 500 – 1,000 devices</td>
<td></td>
</tr>
<tr>
<td>Volt/Var (Two-way Communications)</td>
<td>✓</td>
<td></td>
<td>50 devices</td>
<td>20% of feeders 1,000 – 2,000 devices</td>
<td></td>
</tr>
<tr>
<td>Demand Response</td>
<td>✓</td>
<td>✓</td>
<td>5,000 thermostats</td>
<td>20% of customers 300,000 devices</td>
<td>Phoenix, Yuma, All</td>
</tr>
<tr>
<td>Distributed Energy</td>
<td>✓</td>
<td>✓</td>
<td>20,000 systems</td>
<td>25% of customers 250,000 systems</td>
<td>All</td>
</tr>
<tr>
<td>Electric Vehicles</td>
<td>✓</td>
<td>✓</td>
<td>1,500 cars 2,500 EVSEs</td>
<td>10,000 – 20,000 cars 15,000+ EVSEs</td>
<td>Phoenix, Yuma, Flagstaff</td>
</tr>
<tr>
<td>Energy Efficiency</td>
<td></td>
<td>✓</td>
<td>&lt;10 systems</td>
<td>10% of customers 100,000 systems</td>
<td></td>
</tr>
<tr>
<td>In Home Devices</td>
<td>✓</td>
<td></td>
<td>200 – 400 devices</td>
<td>20% of customers 200,000 devices</td>
<td>All</td>
</tr>
<tr>
<td>Substation Equip Health Monitoring</td>
<td>✓</td>
<td>✓</td>
<td>400 – 600 devices</td>
<td>Non Tier 1 41 MVA Xfrms &amp; Distribution Subs</td>
<td>All</td>
</tr>
</tbody>
</table>
Energy Storage

- Why energy storage?
  - Shift energy to help generation meet load peaks
  - Reduce effects of variability from renewable energy sources
  - Support energy load stability during grid transients

- Potential benefits:
  - Capacity firming for renewables
  - Energy shifting, peak shaving
  - Asset upgrade deferral
  - Power quality improvement (voltage support, regulation, etc)
  - End user cost management (customer Time of Use benefits)

- Risks involved:
  - Increased cost for improved reliability
  - New technologies with less commercial history
Energy Storage - Flagstaff Project

• Project Objectives
  – Establish safe & reliable operation on the APS distribution system
  – Identify successful capabilities and lessons learned from operation
  – Quantify the value proposition provided to APS & its stakeholders

• Project Location - Flagstaff 12kV System

• Technical Focus Areas
  – Storing & shifting energy
  – Reducing rapid PV variability
  – Load profile smoothing

• Potential Value-Adders
  – Infrastructure upgrade deferral
  – Distribution system support
  – Improved renewable resource integration
Energy Storage- Flagstaff Project

• Partners- Electrovaya & ABB
  – Lithium-Ion battery technology coupled with ABB grid interface
  – 500 kW, 3 hour storage capacity
• Phase I – Elden Substation
  – Shift energy to levelize peak load
  – Test operator dispatch vs autonomous grid operation
• Phase II – Doney Park PV Site
  – Regulate energy to reduce short-term PV variability
  – Provide additional distribution support functions

• Schedule
  – System installation – September/October 2011
  – Phase I- Q4 2011 – Q2 2012
  – Phase II- Q3 2012 – Q1 2013
  – Final report & study Q2 2013
Energy Storage- APS Solar Pavilion

• Project Objectives
  – Demonstrate small-scale energy storage coupled with solar PV and electric vehicle charging
  – Identify successful capabilities, values and lessons learned from operation, particularly regarding operation of distributed energy storage systems.

• Technical Focus Areas
  – Store solar PV energy for EV charging during evening
  – Viability of reducing solar variability using distributed storage resources

• Anticipated Schedule
  – Installation late 2011/early 2012
  – Operation during 2012
  – Results in 2013
Energy Storage- CAES

• Engaged University of Arizona in 2009 to develop study on Compressed Air Energy Storage
  – Maturing technology
  – CAES offers promise in providing back up storage for solar and wind energy generation
  – APS is monitoring industry activities and advancements in CAES

• Member of AZRise (UA Consortium)
  – Monitoring ongoing demonstration and study around the advancement of CAES
Electric Vehicles

- Nissan Leaf, Chevy Volt and Ford Focus debut for 2010 and 2011

- ECOtality “The EV Project”
  - $230 million project
  - Charging infrastructure
  - Partnering in Arizona pilot

- System impacts are expected to be at distribution level
  - ~ 6 kW Level 2 charging
  - One EV = one house
  - Continuing to study potential system impacts
  - Developing internal processes
  - Smart charging potential to mitigate

- APS EV-Ready Project
  - Super off-peak rate for EV owners
  - Public charging stations
Current Demand-Side Management (DSM) Programs at APS

Jim Holbrook – Account Executive Senior
Impact of DSM on Retail Sales

- Blue line: Retail Sales -- 2011 Q2 BAU w/o EE
- Red line: Retail Sales -- w/EE 2011 Q2 IRP
Cumulative Savings from DSM

2011 Q2 Projections

GWH

- 2021

2011 Q2 Projections

Cumulative savings from DSM increasing from 2011 to 2021.

DSM Results to Date

Program-to-Date Annual Savings

= 1,090,449 MWh;
= 160 MW

Incremental Annual Energy Savings (MWh)

<table>
<thead>
<tr>
<th>Year</th>
<th>Savings (MWh)</th>
<th>Cost per LT MWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>19,368</td>
<td>$3.2M/19,368</td>
</tr>
<tr>
<td>2006</td>
<td>82,431</td>
<td>$10.6M/82,431</td>
</tr>
<tr>
<td>2007</td>
<td>208,966</td>
<td>$19.4M/208,966</td>
</tr>
<tr>
<td>2008</td>
<td>254,702</td>
<td>$24.2M/254,702</td>
</tr>
<tr>
<td>2009</td>
<td>208,917</td>
<td>$25.6M/208,917</td>
</tr>
<tr>
<td>2010</td>
<td>319,507</td>
<td>$49.8M/319,507</td>
</tr>
</tbody>
</table>

$ per LT MWh $\rightarrow$ $27/MWh, $17/MWh, $10/MWh, $9/MWh, $12/MWh, $14/MWh

(do not include customer investments)
Energy Efficiency Standard

Cumulative Energy Savings as % of Retail Sales

- Est. cumulative energy savings required by 2020 = 6,340,000 MWh
- Achieved to date (2005 to 2010) = 1,090,000 MWh (17% of the way)
More Price Options, More Opportunities to Participate

- Multi-Family Direct Install Refrigerator Recycling Conservation
- Shade Tree Program CFL Bulbs
- Under $10: Home Energy Checkup Advanced AC Tune-up Seasonal Pool Timers
- No Cost: Multi-Family Direct Install Refrigerator Recycling Conservation Behavioral Program
- $50-$100: HPwES Air Sealing Duct Test and Repair HPwES Shade Screens
- $100-$750: E-STAR New Homes Solar Electric (PV)
- $1,000-$3,500: HPwES Insulation Variable Speed Pool Pumps
- $5,000-$10,000: HVAC Replacement Solar Water Heating
- $20,000+: E-STAR New Homes Solar Electric (PV)
## 2012 Residential EE Programs

<table>
<thead>
<tr>
<th>Program</th>
<th>New Features</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Consumer Products</strong></td>
<td></td>
</tr>
<tr>
<td>• CFLs</td>
<td>• Savings etc. updated for EISA (new baseline for 100 watt bulbs</td>
</tr>
<tr>
<td>• Pools</td>
<td>• EISA does not ban incandescents, it requires about a 25% efficiency increase</td>
</tr>
<tr>
<td><strong>Existing Homes HVAC</strong></td>
<td></td>
</tr>
<tr>
<td>• AC Equipment/Quality Install</td>
<td>• Pilot for $100 rebate for Advanced AC Tune-up continues.</td>
</tr>
<tr>
<td>• AC Advanced Tune-up Pilot</td>
<td>• Pilot for performance based rebates as part of Home Energy Check-up program</td>
</tr>
<tr>
<td>• Duct Repair</td>
<td></td>
</tr>
<tr>
<td>• Home Energy Check-ups</td>
<td></td>
</tr>
<tr>
<td><strong>Appliance Recycling</strong></td>
<td></td>
</tr>
<tr>
<td>• Refrigerators and Freezers</td>
<td>• Focus on increasing partnerships with retail outlets to get old fridges from remaining on the grid</td>
</tr>
</tbody>
</table>

## 2012 Residential EE Programs Cont.

<table>
<thead>
<tr>
<th>Program</th>
<th>New Features</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>New Construction</strong></td>
<td></td>
</tr>
<tr>
<td>- Energy Star - V3</td>
<td>- EPA E-Star going to higher version 3 requirements</td>
</tr>
<tr>
<td>- Energy Star - HERS 60</td>
<td>- V3 is 30% &gt; 2006 IECC code</td>
</tr>
<tr>
<td>- Energy Star Plus Solar</td>
<td>- $1000/1500 incentives for builders to meet E-Star V3 Compliance/HERS 60</td>
</tr>
<tr>
<td></td>
<td>- Continue to leverage solar program incentives to achieve close to net zero energy</td>
</tr>
<tr>
<td><strong>Multifamily Energy Efficiency</strong></td>
<td></td>
</tr>
<tr>
<td>- Direct Install</td>
<td>- CFLs, LF shower heads and Faucet Aerators supplied to complex owners who have them installed</td>
</tr>
<tr>
<td>- Builder Option Packages</td>
<td>- Rebates packages available for apartments in different climate zones</td>
</tr>
<tr>
<td><strong>Shade Tree Pilot</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Free trees if customer attends seminar</td>
</tr>
<tr>
<td></td>
<td>- Continue with design and participation at 5,000 trees</td>
</tr>
<tr>
<td><strong>Conservation Behavior Pilot</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Periodic letter showing customer energy usage compared to neighbors</td>
</tr>
<tr>
<td></td>
<td>- Continued with an 80,000 customer test group, 40,000 control group</td>
</tr>
<tr>
<td><strong>Low Income</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Continued integration with our other programs</td>
</tr>
</tbody>
</table>
## 2012 Non-Residential EE Programs

<table>
<thead>
<tr>
<th>Program</th>
<th>New Features</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Solutions for Business</strong></td>
<td>▪ Two new family of measures for all programs</td>
</tr>
<tr>
<td>▪ Large Existing &gt; 100 kw</td>
<td>▪ Energy Management Systems</td>
</tr>
<tr>
<td>▪ Small Business &lt;= 100 kW</td>
<td>▪ HVAC Controls</td>
</tr>
<tr>
<td>▪ New Construction</td>
<td>▪ Lighting Controls</td>
</tr>
<tr>
<td>▪ Schools</td>
<td>▪ LED Lighting</td>
</tr>
<tr>
<td>▪ Energy Information Services</td>
<td>▪ Pedestrian crossing</td>
</tr>
<tr>
<td></td>
<td>▪ LEDs (Screw - in)</td>
</tr>
<tr>
<td></td>
<td>▪ Refrigerated Case Lighting</td>
</tr>
<tr>
<td></td>
<td>▪ MR 16 Lamps</td>
</tr>
</tbody>
</table>
Measurement, Evaluation & Research (MER) Process

- Constant effort to validate savings and improve EE programs with MER process
- Annual review of savings etc. by Navigant Consulting
  - Review of relevant studies
  - Updates to demand and energy savings annually
- Several field studies in APS service territory
  - AC Quality Install last summer
  - Advanced AC Tune-up
  - Residential Pool Motors
Summary – EE in the IRP

- EE is currently the lowest cost resource
- IRP is modeled with compliance to the Energy Efficiency Standard
- Working with DSM Collaborative group on program direction
- On track to meet the EE standard goals for 2011
- Questions?
APS 2012-2016 Renewable Energy Implementation Plan Overview

Greg Bernosky, Renewable Energy Regulatory Planning Leader
Regulatory Commitments

- **Renewable Energy Standard ("RES") Total Energy Requirement**
  - 15% of retail sales by 2025
  - 3% target in 2011, increases ½% annually through 2015, increases by 1% annually (2016-2025)

- **Distributed Energy Requirement**
  - Minimum 25% of the RES total energy requirement in 2011, plateaus at 30% in 2012
  - 50/50 annual targets for residential/non-res customers

- **2009 Rate Case Settlement requires 3.4 million MWh by 2015**
  - Approximately 11% of retail sales
2012 Implementation Plan Overview

- Ensures APS will exceed total RES compliance each year from 2012-2016
- Provides program options for achieving 2015 Settlement requirement
- Builds on expected Renewable Generation and Distributed Energy projects in-service by year-end 2011
- Considers existing contracts and commitments
- Allows the Commission to weigh renewable energy policy considerations
“Gap” Energy Needs Through 2015

- Remaining Energy to Achieve Settlement Requirement
- In Development (79% solar, 20% wind and 1% biogas)
- In Operation (52% wind, 29% solar, 10% biomass, 7% geothermal and 2% biogas)

“Gap” energy is approximately 300 MW of PV capacity through 2015
## 2012 Program Options

<table>
<thead>
<tr>
<th>Options</th>
<th>Option 1</th>
<th>Option 2</th>
<th>Option 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Third-party PPAs for Renewable Generation</td>
<td>Emphasis on utility-scale, central station RG</td>
<td>Moderated amount of RG, allowing for some non-residential incentive program capacity</td>
<td>Less RG capacity to support DE emphasis</td>
</tr>
<tr>
<td>Third Party and Customer Sited Projects</td>
<td>150 MW</td>
<td>125 MW</td>
<td>100 MW</td>
</tr>
<tr>
<td>Non-residential Distributed Energy Incentives</td>
<td>Existing commitments achieve compliance, no new incentives offered</td>
<td>Limit incentives to small and medium projects only</td>
<td>Continue incentives for all project size categories</td>
</tr>
<tr>
<td>Residential Distributed Energy Incentives</td>
<td>Achieve annual compliance target only</td>
<td>Exceed compliance in 2011, maintain margin through 2016</td>
<td>$40M budget in 2012, reduced by $5M annually to 2016</td>
</tr>
<tr>
<td></td>
<td>$20 M</td>
<td>~$30 M</td>
<td>$40 M</td>
</tr>
<tr>
<td>150 MW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Third-party developed, APS owned projects</td>
<td>AZ Sun Program Expansion, Schools and Government Program expansion and other customer-sited community solar projects</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| 2012 Budget | $ 129.2 million | $ 141.2 million | $ 151.5 million |
| 2012 RES Adjustor (Residential Cap)         | $5.43            | $5.96            | $6.41            |
| 2012 – 2016 Program Budget                  | $ 783.1 million  | $ 810.2 million  | $ 873.8 million  |
RES Requirement and Settlement Compliance

Exhibit 1C: Energy Contributions to RES By Resource Group

Settlement Level of Renewable Energy
Renewable Generation
APS Renewable Generation Portfolio

Diversified Renewable Portfolio
APS selects renewable energy projects based on what is the best fit for its load and the best price for customers.

Existing Projects

1. Saguaro
   - Concentrating Solar (1 MW)
   - Solar (90 MW)

2. Star Center
   - Small Solar Across AZ
   - Photovoltaic Solar (3 MW)

3. Prescott
   - Photovoltaic Solar (1 MW)

4. Aragonne Mesa
   - Wind (90 MW)

5. High Lonesome
   - Wind (100 MW)

6. Snowflake
   - Biomass (20 MW)

7. Salton Sea
   - Geothermal (10 MW)

8. Glendale Landfill
   - Biogas (3 MW)

9. Solana
   - Concentrating Solar (250 MW)

10. Ajo
    - Photovoltaic Solar (5 MW)

11. Prescott
    - Photovoltaic Solar (10 MW)

12. Hyder
    - Photovoltaic Solar (13 MW)

13. Chino Valley
    - Photovoltaic Solar (10 MW)

14. Cotton Center
    - Photovoltaic Solar (17 MW)

15. Luke AFB
    - Photovoltaic Solar (14 MW)

16. Perrin Ranch
    - Wind (99 MW)

17. Paloma
    - Photovoltaic Solar (17 MW)
APS Renewable Resource Options

**Solar – Highest Opportunity**
- Arizona averages 300 days of sunshine a year
- Geographic diversity readily achieved
- Incremental and scalable

**Wind – Moderate Opportunity**
- Best sites located across Northern Arizona
- Some good sites but not as strong as some states
- Transmission availability limits accessibility to some sites
- Limited resource planning value – energy

**Biomass – Limited Opportunity**
- Arid state means only limited opportunities for biomass

**Geothermal – Low Opportunity**
- No commercially viable sites identified in the state (at this time)
- Good potential in neighboring states
Future Procurement Needs

- AZ Sun Tranche 2 (17 MW) RFP – Q3 2011
- 2012 Small Generation RFP – Spring 2012
- Additional PPA capacity RFP – 2012, target COD by early 2015
- AZ Sun Tranche 3 (18 MW) – 2013 COD
- AZ Sun Tranche 3 (32 MW) – 2014 COD
- AZ Sun Tranche 3 (50 MW) – 2015 COD
Distributed Energy
Customer participation in APS DE programs has remained high despite declining incentive levels.
2012 Residential DE

Estimated MWh Production and Costs (2012 only)

- Option 1 – meet RES Requirement
- Option 2 – expand program based on expected production by year-end 2012
- Option 3 – $40M option for Commission consideration

Expected year-end 2011 capacity is 109% of residential DE target
Five-Year Residential DE Options

Exhibit 1D: Residential Customer Sited Distributed Energy

- Option 1
- Option 2
- Option 3
- Installed (est. '11)
- Residential DE Requirement

MWh
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0

2012
2013
2014
2015
2016
APS – Committed to Clean Energy

• APS is committed to a resource portfolio of clean and renewable energy

• Continued study of and improvements to the integration of renewables to the electric grid are necessary

• APS will continue to show industry leadership in renewable energy planning and development
APS Water Resources Update

Bob Lotts, Water Resource Planning Manager
Laura Grignano, Water Resource Planner
State Water Supply

In 2006, approximately 7 MAF of water was used to meet statewide demand

- **Groundwater**: 2.6 MAF (38%)
- **Instate Surface Water**: 1.2 MAF (18%)
- **Reclaimed Water**: 0.2 MAF (3%)
- **Colorado River/CAP**: 2.8 MAF (41%)

Source: Arizona Department of Water Resources
State Water Demand

2006 Arizona Water Use and 2009 Arizona Power Plant Water Use (Acre-Feet)

- Agriculture: 5,168,825 AF (73%)
- Municipal: 1,524,510 AF (21%)
- Industrial Use other than Energy: 233,959 AF (6%)
- Arizona Power Plant Water Use: 176,132 AF (3% of Total State Water Use)

Source: Arizona Department of Water Resources
APS Power Plant Water Use
2006 - 2010

G/MWH

- Nuclear
- Coal
- Gas

770
582
367
Percentages next to each plant represent the proportion of that source type used by that plant.
Water Resource Development Commission (WRDC)

- 2010 Commission study of water use by all sectors - municipal, industrial, agricultural
- Representatives from all sectors participate (APS, SRP & TEP represented the power sector of industry)
- Population based study – all results based upon growth projections
- Final report by WRDC due in November, 2011
## Planning for the Future

<table>
<thead>
<tr>
<th>Resource</th>
<th>Advantages</th>
<th>Concerns</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Effluent</strong></td>
<td>• Long-term contract</td>
<td>• Contract termination date</td>
</tr>
<tr>
<td></td>
<td>• Environmentally compatible</td>
<td>• Treatment costs are high</td>
</tr>
<tr>
<td></td>
<td>• Recharge and recovery options</td>
<td></td>
</tr>
<tr>
<td><strong>Surface Water</strong></td>
<td>• Treatment costs are typically low</td>
<td>• Vulnerable to drought conditions</td>
</tr>
<tr>
<td></td>
<td>• Potential to store and recover</td>
<td>• Acquisition cost high</td>
</tr>
<tr>
<td><strong>Groundwater</strong></td>
<td>• “Perpetual” rights with physical availability limitations</td>
<td>• Sub-flow issues</td>
</tr>
<tr>
<td>Type I: Dedicated</td>
<td>• Up front cost to drill well</td>
<td></td>
</tr>
<tr>
<td>Type II: Flexible</td>
<td>• Treatment costs typically low</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Type II rights provide flexibility</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• “Perpetual” rights with physical availability limitations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Use restrictions in AMAs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• View as non-renewable resource</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Sub-flow issues</td>
<td></td>
</tr>
</tbody>
</table>

*Output from wastewater treatment plants*
Decision Modeling Center

• GIS system to facilitate water resource analysis and modeling throughout Arizona
  – Complete mapping information
  – Environment to develop water use forecasts based on long-term generation forecasts
  – Integration with Groundwater Modeling, providing output analysis and visualization
APS Power Plants

APS-Operated Plants by Location

Phoenix AMA
- Palo Verde
- Redhawk
- West Phoenix
- Ocotillo

Tucson AMA
- Saguaro

Pinal AMA
- Sundance

Joseph City INA
- Cholla

Outside AMA/INA
- Four Corners
- Yucca

“AMA” is Active Management Area
“INA” is Irrigation Non-Expansion Area
Web Map – Plats, Pipeline, Wells
Web Map – Enhanced Data Points
Groundwater Model Output
Future Water Intensity

Annual Water Use (Acre-Feet) & Water Rate (Gallons/MWh)

- Water Usage
- Water Usage w/o EE and RES Standards
- Water Usage BAU
- Water Rate (Gallons / MWh)

Water Usage
Water Usage w/o EE and RES Standards
Water Usage BAU
Water Rate (Gallons / MWh)
Water Energy Nexus

Laura Grignano
Water Energy Nexus

• Governor’s Blue Ribbon Panel on Water Sustainability Recommendation
  - Conduct an AZ specific study that identifies the amount of water in energy and the amount of energy in water as well as an evaluation of the tech/operational feasibility of dry and hybrid cooling

• APS looked into what a study of this magnitude might look like and cost

• Discovered that Sandia Laboratory was beginning a 2 year project that appears to have similar objectives
Energy and Water in the Western and Texas Interconnects

Vincent Tidwell
Sandia National Laboratories
Albuquerque, New Mexico

Arizona Public Service
Phoenix, AZ
May 11, 2011
Project Partners

- Sandia National Laboratories
- Argonne National Laboratory
- Electric Power Research Institute
- National Renewable Energy Laboratory
- Idaho National Laboratory
- Pacific Northwest National Laboratory
- University of Texas

Source: Sandia Laboratories, Dr. Tidwell
Water Energy Nexus

• Sandia Project Objective:
  – Develop an integrated Energy-Water Decision Support System (DSS) to analyze the potential water stress implications for transmission and resource planning
  – Investigate the water stress implications of planning scenarios put forward by WECC, ERCOT and the WGA
Water Energy Nexus

Western Interconnect (WECC)

Source: Figure taken from Sandia Project Proposal, Energy and Water In the Western and Texas Interconnects
Water Energy Nexus

• Sandia Project Methodology:
  
  – Update and expand an existing Sandia Energy/Power/Water simulation model
  
  – Create user friendly interface or “dash board” that allows the user to create scenarios
  
  – Arizona has been chosen as one of four pilot study states
Driving Questions

• How much new water is required?

• How “difficult” would it be to acquire new water in a given basin?

• How “vulnerable” are existing plants to drought related water supply disruptions?

• What limited set of metrics best characterize answers to these questions?
Thermoelectric Water Use

- Water Withdrawal and Consumption by Power Plant
  - Current, and
  - Future Fleet.

- Potential Policy Changes
  - Open Loop Cooling
  - Carbon Capture and Sequestration

Source: Sandia Laboratories, Dr. Tidwell
Water Availability Indicators

- Water Demand
- Water Supply
- Drought Vulnerability
- Institutional Factors
- Value of Water

Source: Sandia Laboratories, Dr. Tidwell
Water Availability Indicators: Demand

- **Focus on withdrawals**
- **Estimate consumption from withdrawals**
- **Disaggregate by:**
  - 8-digit watershed
  - Sector
    - M&I
    - Agriculture
    - Evaporative
    - Instream
  - Water source

Source: Sandia Laboratories, Dr. Tidwell
Water Availability Indicators: Demand

- **Projected growth**
  - High and
  - Low cases

- **Identify state projected growth areas for power production**

Source: Sandia Laboratories, Dr. Tidwell
Water Availability Indicators: Supply

Mean Gauged Streamflow

Annual Low Flow

Interbasin Transfers

Non-Tributary Groundwater

Reservoir Storage

Accessible Non-Potable Sources

Source: Sandia Laboratories, Dr. Tidwell
Water Availability Indicators: Drought Vulnerability

- Plant Vulnerabilities
  - Physical factors,
  - Water rights,
  - Environmental constraints

- Decreased Hydropower Production

- Reduced Streamflow

- Increased Power Demand

Source: Sandia Laboratories, Dr. Tidwell
Plant Level Evaluation/Tradeoffs

**Cooling Options**

**Plant Options**

- Fuel Type and Location

**Evaluation Metrics**

- Reliability
- Cost

**Source Options**

- Wet Cooling
  - Surface Water
  - Ground Water
- Non-Potable

Source: Sandia Laboratories, Dr. Tidwell
Water Energy Nexus

• Next Steps
  – Second meeting with Sandia (Aug-Sept)
  – Include SRP and TEP in the discussions
  – Provide time, personnel and expertise to the effort
APS Energy Savings Per the Energy Efficiency Standard (22% Savings by 2020)

- Cumulative annual energy savings exceed 6,800 GWh in 2020; ~ $7 billion in bill savings (2011-2030)
- Annual savings exceed 2% starting in 2013

LBNL Energy Analysis Department, Electricity Markets and Policy Group
The Effect of Much Higher EE Savings Due to the Energy Efficiency Standard

- Energy efficiency is *one-fifth* of the energy “pie” in 2020
- Lower total costs, lower utility bills, more jobs, less pollution
- Deferral of three large baseload plants from early 2020’s to 2030’s (and by then renewables, storage, electric vehicles, etc.)
- Plus $9 billion in lower customer bills (2011-2030)
Energy Efficiency: The Most Cost-Effective Energy Resource

APS: 2010 Costs of New Generation

Energy Efficiency: The Most Cost-Effective Energy Resource

APS: Lifetime Levelized with 2015 In-Service Date

Energy Efficiency Portfolios: Screened to Ensure That Cost-Effective Programs are Implemented

• All Programs must be cost-effective (benefits exceed the costs)
• Cost effectiveness assessment compares the benefits (avoided costs of energy and capacity) to the costs of the program (sum of program costs and customer costs)
• Independent review and analysis of cost-effectiveness by Commission Staff
• Commission review and approval
APS Customers on Energy Efficiency: Least Expensive, Least Harmful Resource

Results from the APS Informed Perception Project

Energy Efficiency Programs

Representative Sample: 1,070 Customers

159 Customers, 1 Month After Education

Source: Morrison Institute for Public Policy, 2011.
Energy Efficiency Portfolios: Continuous Review and Improvement to Maximize Performance

**Results from MER in Prior Years/Projects**

- Plan
- Implement
- Track (Tracking System)
- Evaluate (MER)
- Report

**Diagram:**
- Plan
- Implement
- Track (Tracking System)
- Evaluate (MER)
- Report
The Portfolio of Programs Exceeds the Goals Even Though the Performance of Individual Programs May Vary

APS: 2010 Planned & Achieved Savings for Portfolio & Select Programs
EE Uncertainties for Resource Planning and how the Uncertainties are Addressed

• Some uncertainty about what actions customers will take and when (and this can be influenced by programs and offerings)

• But once measures are installed...
  – Virtually no cost uncertainty
  – Very small uncertainty about performance (the actual energy savings are achieved or exceeded in most years, at portfolio level, documented in many studies)

• Flexible and responsive resource; under-performance in one year can be addressed in the next year or future years
Need to be Clear What we are Planning

Tracking Energy-Efficiency Resources in Load Forecasts

- pre-plan period
- plan analysis period

unadjusted load forecast: total resource requirements

net resources for load

plan-period EE programs
pre-plan EE programs
plan-period EE standards
pre-plan EE standards
plan-period building codes
pre-plan building codes
load met with supply-side resources (not to scale)

WGA goal: 20% EE by 2020

2006 plan start ← plan end 2020
Regulatory Treatment to Align Utility Incentives with the Interests of Customers

Utility financial incentives should be aligned with the public interest and the interests of customers

1. Ensure recovery of prudent program costs (timely cost recovery)
2. Reduce the utility financial disincentive (unrecovered fixed costs; address through decoupling)
3. Provide a positive financial incentive (performance incentive)

The Commission has approved the first and third treatments; consideration and action are needed on the second