Drivers and Key Assumptions

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Resource Planning
Drivers and Key Assumptions

- Climate Change
  - (next stakeholder meeting)

- Cost Escalation

- Transmission Needs

- Water Use

- Natural Gas Prices and Infrastructure

- Emission Prices and Environmental Assumptions

- RES Implementation

- Analysis Process
Construction Cost Escalation

Year

1995 1997 1999 2001 2003 2005 2007

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160
140
120
100
80
60
40

RS Means  Handy-Whitman  GDP

A subsidiary of Pinnacle West Capital Corporation
Available Transmission Versus Net Resource Needs
(includes projects in current 10 year plan)

Eliminate the gap by:
1. Reducing load thru energy efficiency, DR or DE
2. Build transmission to remotely-located resources (conventional or renewable)
3. Site and build new generation resources inside the transmission-constrained area
4. Purchase wheeling services from another provider
Transmission Needs

• **Transmission Needs are Factored into the Resource Planning Process:**
  
  – Available APS transmission determined for each year in the study period
    • Based upon projects in 10 year plan and expiration of existing resources
  
  – Transmission needs assessment conducted for each unique resource scenario or alternative:
    • Identify additional transmission needed to implement resource plan
      – What is required to interconnect and deliver new resources to the load center
    • Estimate capital costs and timing of new transmission

  – Assumed locations of resources for transmission purposes:
    • Generic gas-fired resources located either in load pocket or within 15-30 miles of valley transmission network
    • Solar assumed in the area west of Palo Verde and Gila Bend (utilize PV-east transmission path)
    • Wind resources from multiple locations including New Mexico and northern Arizona areas in proximity to Cholla and the Navajo transmission system
    • Geothermal assumed in the Salton Sea area of California

• **Range of Transmission Costs Included in Resource Scenarios:**

  • Capital costs over $1 B (20 year period thru 2027)
    – (does not include projects already identified in the 10 year plan)
Water Use

• **Water Consumption is a Significant Factor in Electricity Generation:**
  - Average water consumption for conventional, wet-cooled generation sources (Year 2007 data):
    - Redhawk Gas Combined Cycle 296 gallons/MWH (note – RH uses treated sewage effluent)
    - Cholla Coal 681 gallons/MWH

• **Considerations for Future Energy Sources:**
  - Several energy sources require little or no water:
    - Energy efficiency
    - Distributed energy sources (roof-top solar PV, solar hot water, etc.)
    - Wind
    - Utility-scale solar photovoltaic
  - Can utilize dry or hybrid cooling technologies to decrease water consumption
    - Proposed Desert Rock coal plant (being developed by Sithe) is proposed to use hybrid cooling techniques to reduce water use:
      » 130 gallons/MWH (APS calculations based upon data from draft EIS)
    - Dry-cooled gas combined cycle:
      » 30 gallons/MWH (summer usage with evaporative coolers on)
  - Utilization of low quality or effluent sources
    - Palo Verde nuclear plant uses treated sewage effluent from 91st Avenue treatment plant

• **Assumptions used in APS Resource Planning Analysis:**
  - Water-saving technologies utilized for future resource analysis (generic planning assumptions, not a fully designed plant):
    - Dry-cooled gas combined cycle
    - Hybrid-cooled pulverized coal unit (annual average of 320 gallons/MWH)
  - Trade-offs between water consumption, capital cost, plant efficiency, CO2 emissions
Natural Gas Price Forecast

$/mmBTU

Historic ↔ Market → Escalated

* Represents annual average delivered gas price
Gas Pipeline Infrastructure and Additions

ARIZONA

San Juan Basin

New Mexico

Anadarko Basin

Permian Basin

CA

Transwestern 7/2008

North Baja Pipeline to Costa Azul LNG
Q2 2008 with lateral to Yucca 2009
Western Infrastructure Additions
Emission Prices and Environmental Assumptions

• Currently Regulated Emissions are Explicitly Included in Resource Planning Analysis:
  – SO2 Allowance Market
    • Surplus/Shortage of allowances valued in the economic analysis
    • Forecast of allowance prices based upon a combination of market and fundamental forecast
      – Range from 321 $/ton (2010) to 496 $/ton (2025), in nominal $’s
  – Hg Assumption of a Cap-and-Trade System
    • Surplus/Shortage of allowances valued in the economic analysis
      – Assumed to start in 2010
    • Forecast of allowance prices based upon a fundamental forecast
      – Range from approximately 19,000 $/lb (2010) to 75,000 $/lb (2025), in nominal $’s
  – Generic, New Resources Include Required Control Technologies, for example:
    • Gas-Fired Combined Cycle Includes SCR and COR catalyst

• Fossil Plant Emission Rates are Modeled:
  – Provides for quantification of key emissions for each resource planning scenario:
    • CO2, SO2, CO, NOx, PM10, Hg

• CO2 Addressed Thru Risk Analysis:
  – Low, Medium and High Scenarios evaluated:
    • Medium starts in 2012 at 9 $/ton and increases to 19 $/ton by 2025
    • High starts in 2012 at 12 $/ton and increases to 56 $/ton by 2025
RES Implementation

- Resource Scenarios Include Costs/Resources to Comply with RES Targets:
  - Minimum renewable energy included in each scenario achieves RES compliance plus expected needs under the green energy tariff
Analysis Process

• **Modeling Assumptions:**
  
  – New, conventional generation modeled as APS-owned
    • Simplifies analysis for resource comparison purposes
    • Not intended to specify the procurement method
  
  – New, renewable resources modeled as PPAs
    • Price assumptions based upon wide range of market observations

• **Key Results of the Analysis Process:**
  
  – Economic Factors:
    • Annual revenue requirements
    • Average system cost ($/MWH)
  
  – Capital Requirements
  
  – Natural Gas Consumption
  
  – Transmission Requirements
  
  – Emissions Quantification
  
  – Energy Mix (Portfolio Diversity)