

Drivers and Key Assumptions

Brad Albert
Director – Resource Planning

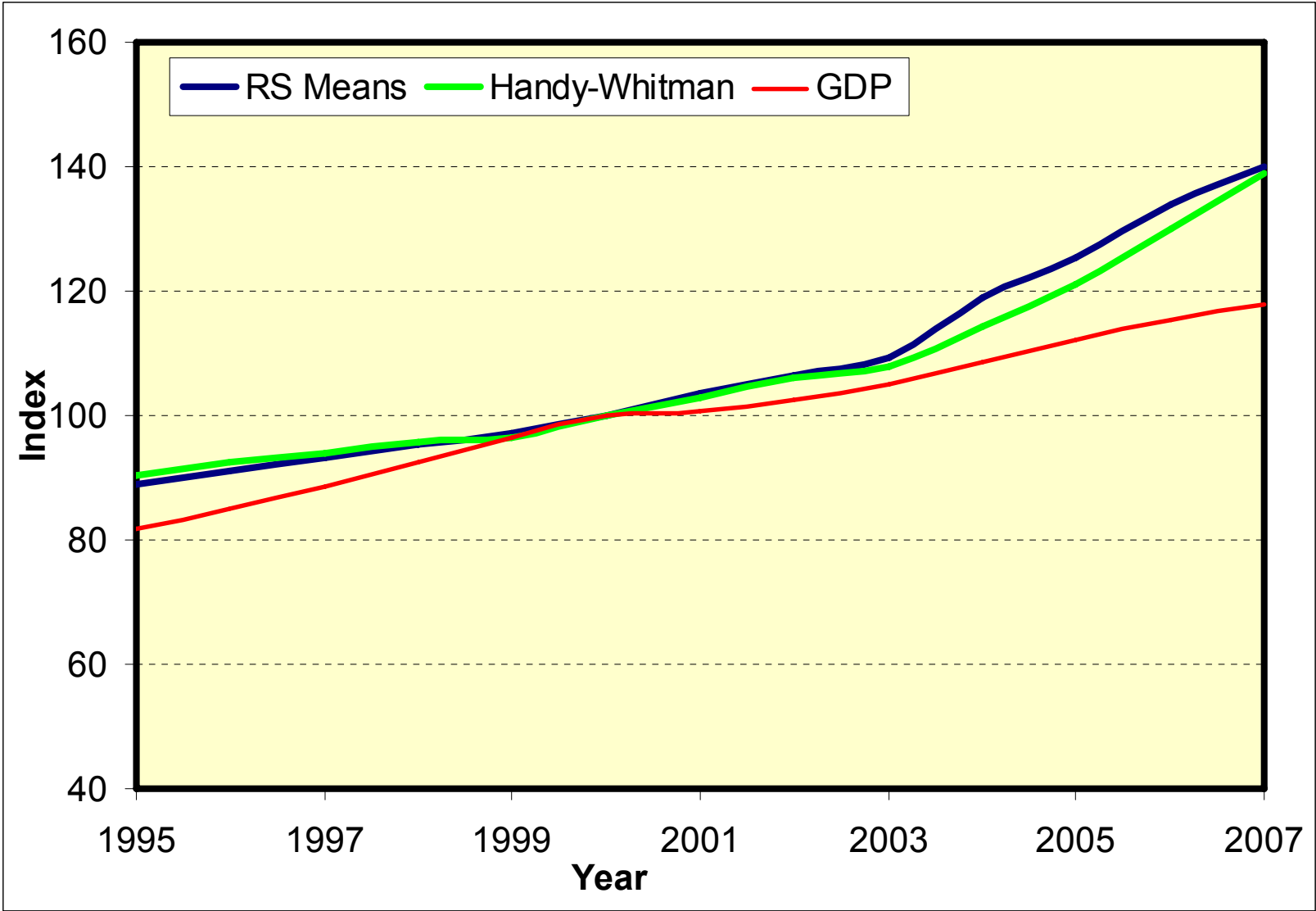
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Resource Planning

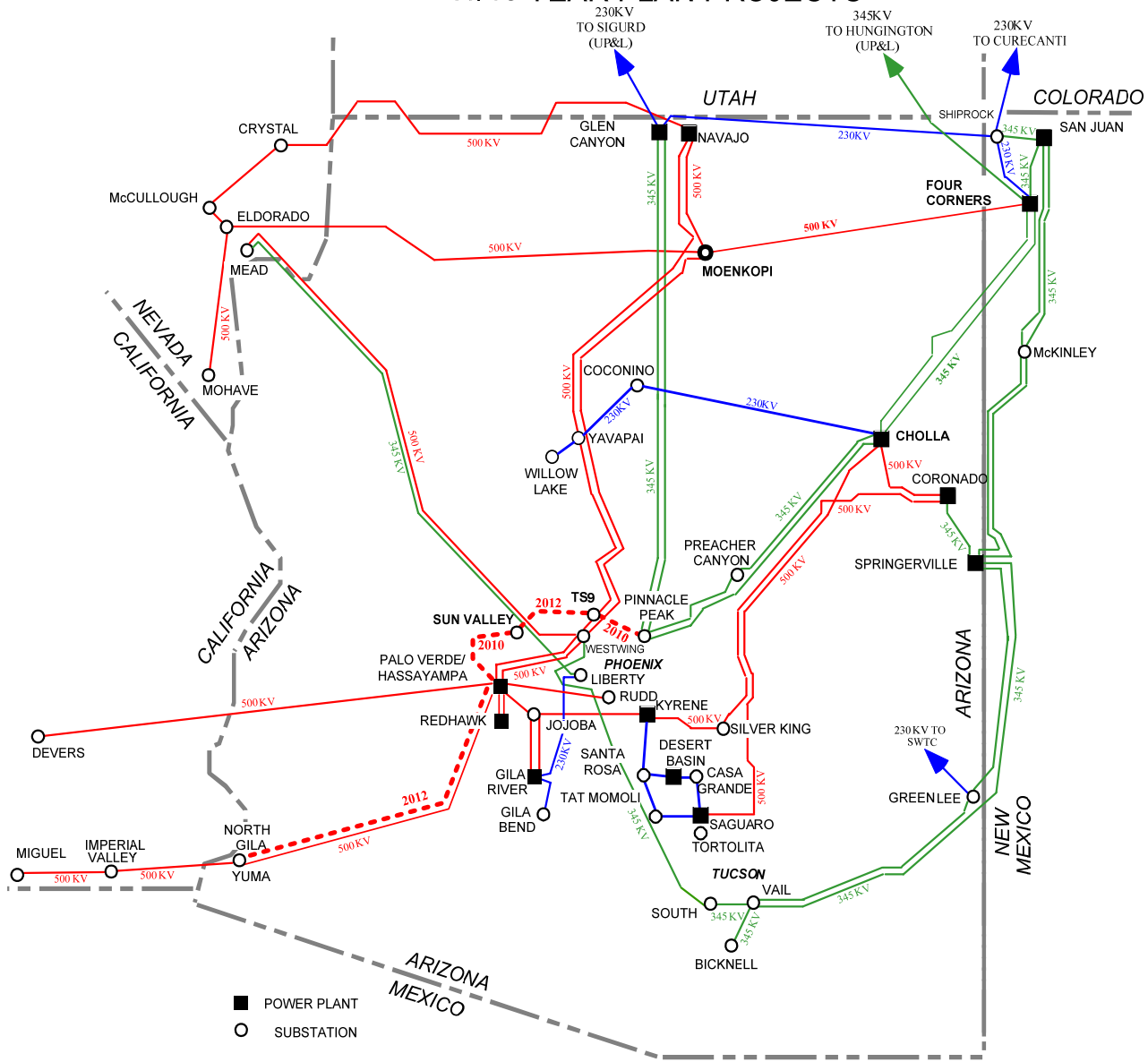
Drivers and Key Assumptions

- **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

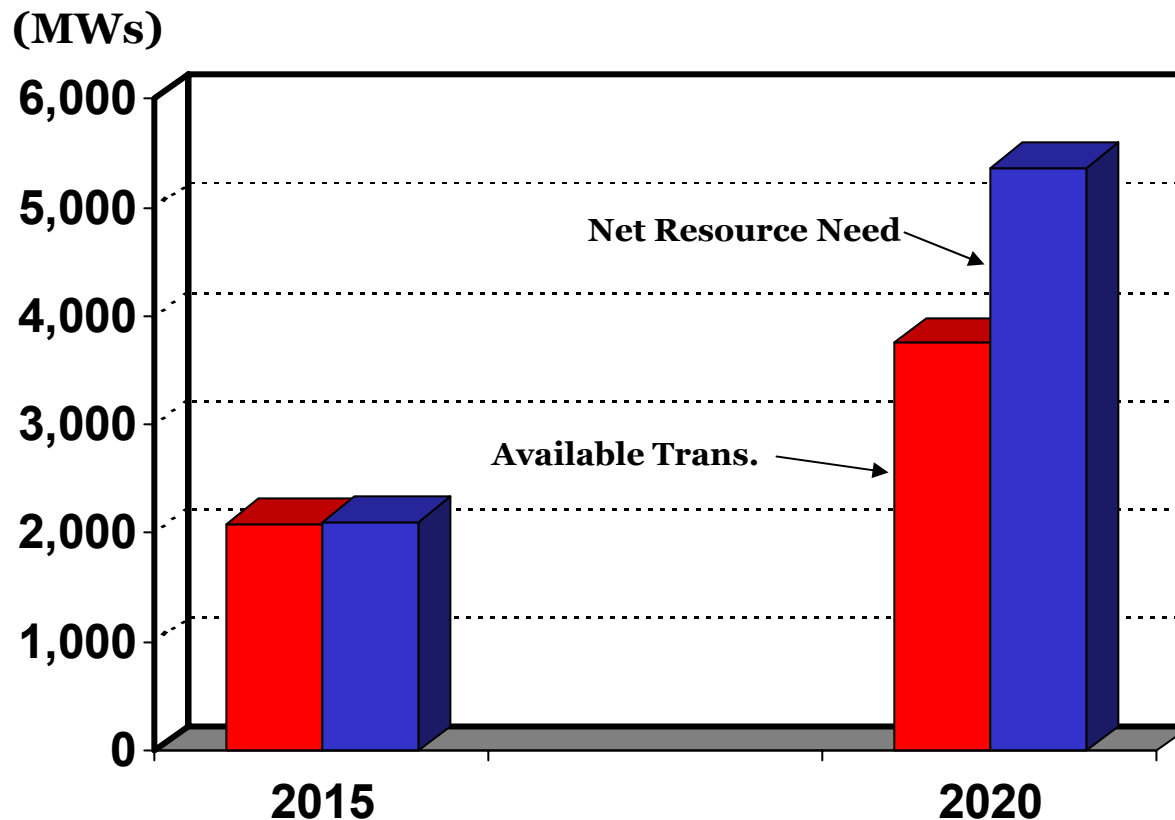


ARIZONA TRANSMISSION SYSTEM W/10 YEAR PLAN PROJECTS



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

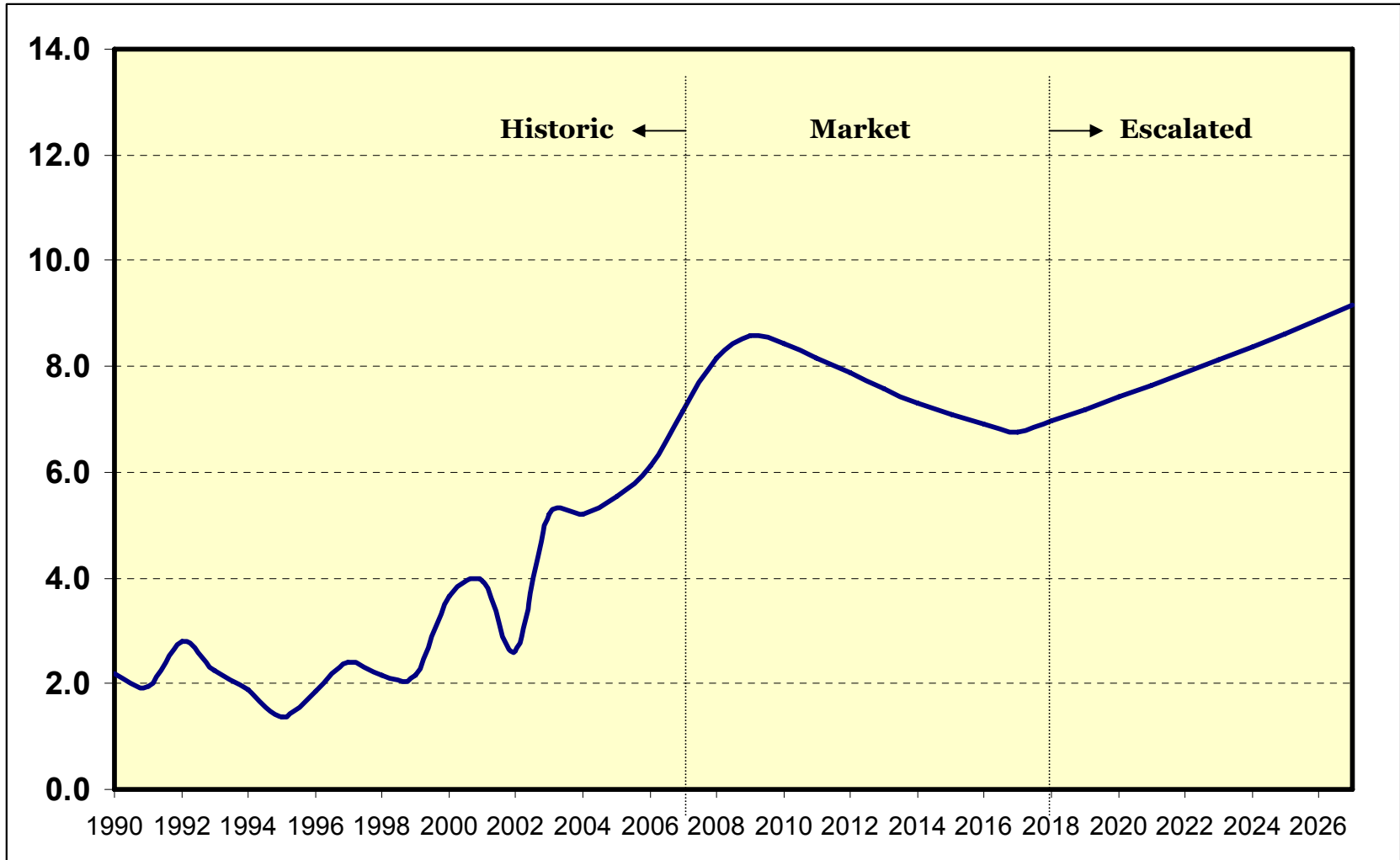
- **Transmission Needs are Factored into the Resource Planning Process:**
 - Available APS transmission determined for each year in the study period
 - Based upon projects in 10 year plan and expiration of existing resources
 - Transmission needs assessment conducted for each unique resource scenario 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

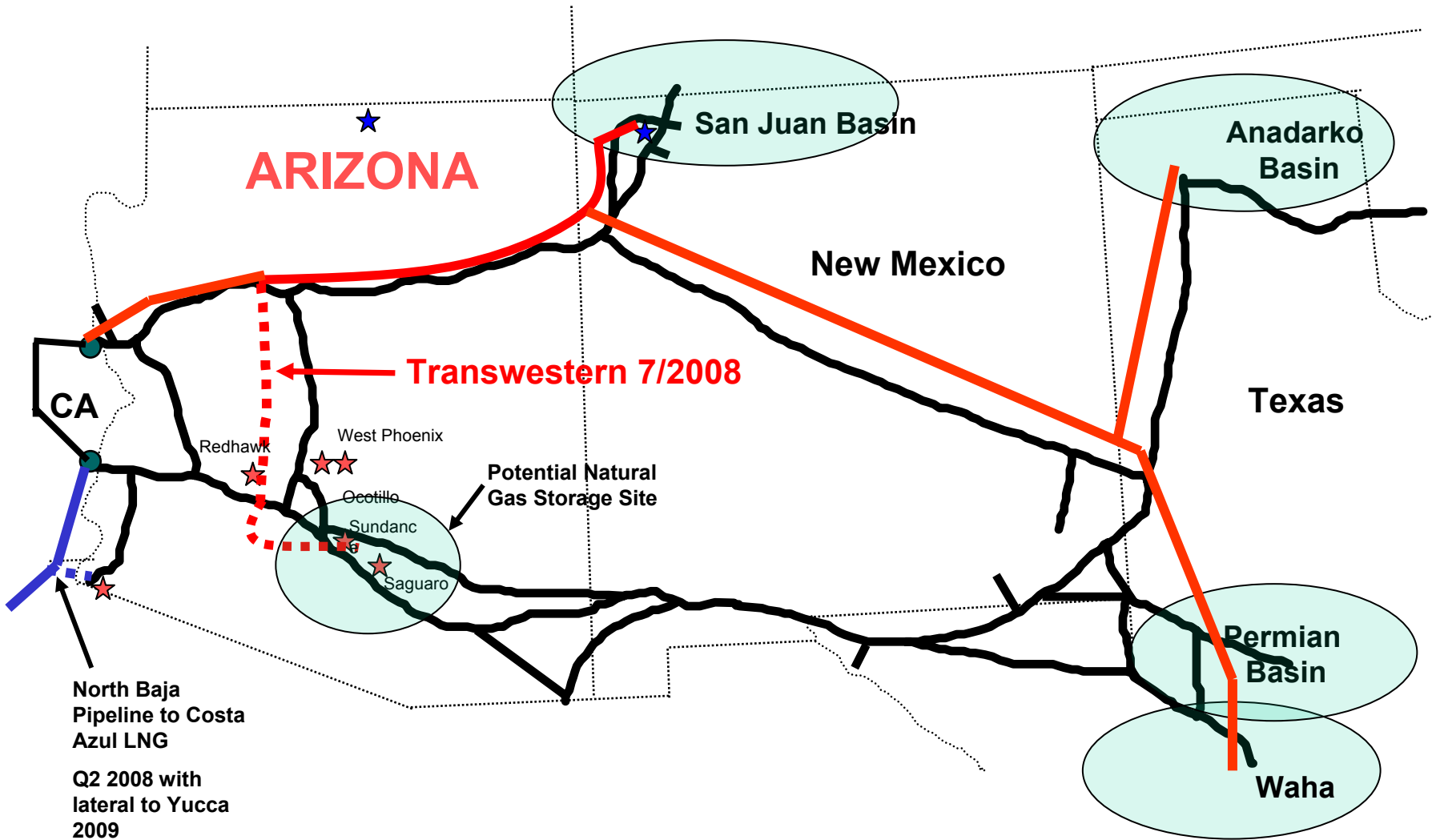
Natural Gas Price Forecast

\$/mmBTU



* Represents annual average delivered gas price

Gas Pipeline Infrastructure and Additions



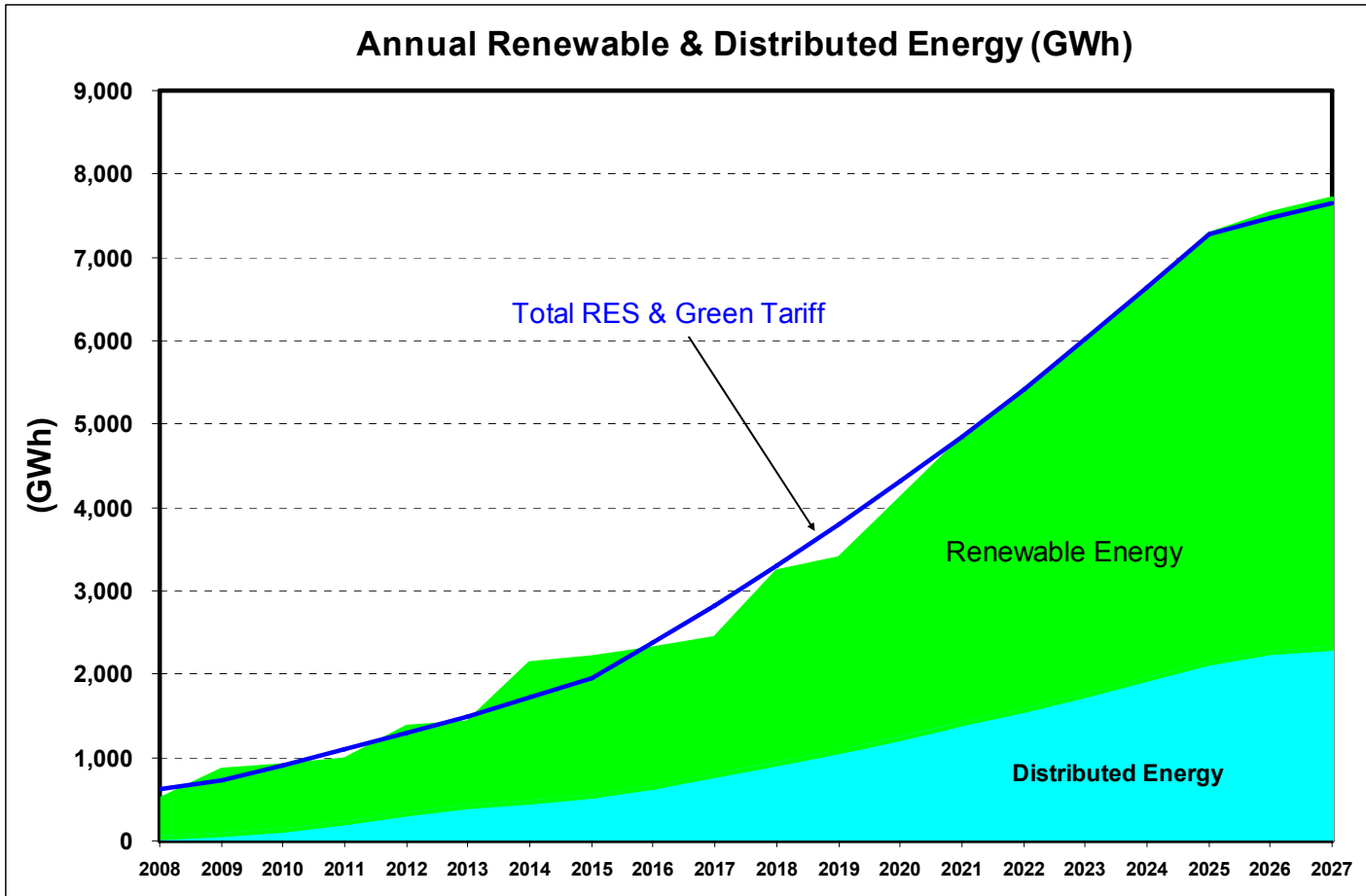
Emission Prices and Environmental Assumptions

- **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, NO_x, 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)