July 20, 2016

Docket Control
Arizona Corporation Commission
1200 W. Washington
Phoenix, Arizona 85007


Attached is APS’s Integrated Resource Planning Workshop Presentation used during the Special Open Meeting on July 18, 2016.

If you have any questions, please contact me at (602)250-3341.

Sincerely,

Kerri A. Carnes

KC/ks
Attachment
Flexibility for the Future

Integrated Resource Planning Workshop

July 18, 2016

Jim Wilde
Director, Resource Planning

Jeff Burke
Manager, Resource Analysis
Agenda

- Key Planning Drivers
- Evolving Load Patterns and Markets
- Forecasting
- Resource Needs
- Technologies Being Evaluated
- Customer Resources - Flexible Demand Management
- Action Plan Update
- Portfolios and Sensivities
- IRP Process Considerations
Key Planning Drivers

- Low natural gas prices
- Cost of environmental regulations
- Growth of renewable energy
Low Natural Gas Prices

- Favorable outlook
  - Stable long-term price forecast
  - Low emissions

- Flexible generation
  - Meets peak demand and integrates variable energy resources

- Greater Utilization
  - 2015 marked first year that the capacity factor for natural gas was greater than coal nationally
Cost of Environmental Regulations

- Economies of scale favor larger units
- Emissions and water efficiency improvements
- Cholla
  - Retired Unit 2 (260 MW)
  - No longer burning coal Units 1,3 post 2025
  - Evaluating Units 1,3 on-going operations
- Navajo
  - Evaluating operations post 2019
- Four Corners
  - Retired Units 1-3 (560 MW)
  - Investing in SCR technology for Units 4-5
Growth of Renewable Energy

- Renewable production on the APS system has increased from 1,350 GWH’s in 2012 to over 3,000 GWH’s today
- Solar and wind production in CAISO has grown from 14,000 GWH’s in 2012 to about 40,000 GWH’s today

*Source: IHS Report "North America Renewable Power Market Forecast, 2016–30"
Growth in Installed Capacity Expected to Continue

- California RPS increased to 50% by 2030
- Solar forecasted to be roughly 70% of installed renewable capacity

Evolving Load Patterns and Markets

- Net load shapes and wholesale market prices have changed due to increasing levels of renewable energy
- Economic purchase opportunities
- APS will need a more flexible resource portfolio to respond

* Source: http://oasis.caiso.com/mrioasis/logon.do
Distributed Generation Projections for Planning

- Roughly 500 MW of rooftop solar currently on APS’s system
- APS customers installing roughly 100 MW of rooftop solar per year
- Very little rooftop solar production at time of peak customer demand
Summer System Load Factor
Effects of EE and Rooftop Solar (Jun-Aug)

- Energy efficiency and rooftop solar impact net energy consumption, but have limited impact on meeting peak demand
- Low load factor resources drive the need for a more flexible asset mix
Load Forecasts

- Peak Demand and Sales Forecast (2017-2032)
  - Peak demand after EE and rooftop solar = 2.4% annual growth rate
  - Retail sales after EE and rooftop solar = 1.5% annual growth rate

- Historical Growth Rates
  - Peak Demand
    - Years 2000 to 2007 = 4.6%
    - Years 2008 to 2015 = 1.5%
  - Retail Sales
    - Years 2000 - 2007 = 3.7%
    - Years 2008 - 2015 = 1.1%

- Load Requirements by Class
  - Residential = 60%
  - All others = 40%
## Existing Resources

### Capacity By Type for Year 2016

<table>
<thead>
<tr>
<th>Type</th>
<th>Nameplate</th>
<th>On Peak</th>
<th>Peak Need</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear</td>
<td>1,146</td>
<td>1,146</td>
<td>1,146</td>
</tr>
<tr>
<td>Coal</td>
<td>1,672</td>
<td>1,672</td>
<td>1,672</td>
</tr>
<tr>
<td>Gas/Oil Owned</td>
<td>3,106</td>
<td>3,106</td>
<td>3,106</td>
</tr>
<tr>
<td>Solar Owned</td>
<td>524</td>
<td>430</td>
<td>430</td>
</tr>
<tr>
<td>Wind</td>
<td>283</td>
<td>55</td>
<td>55</td>
</tr>
<tr>
<td>Geo / Biomass / Landfill</td>
<td>29</td>
<td>29</td>
<td>29</td>
</tr>
<tr>
<td>Purchases</td>
<td>1,911</td>
<td>1,911</td>
<td>1,911</td>
</tr>
<tr>
<td>Rooftop Solar (additional)</td>
<td>79</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>Energy Efficiency (additional)</td>
<td>109</td>
<td>109</td>
<td>109</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>8,859</strong></td>
<td><strong>8,472</strong></td>
<td><strong>7,940</strong></td>
</tr>
<tr>
<td><strong>Existing Rooftop Solar</strong></td>
<td><strong>490</strong></td>
<td><strong>161</strong></td>
<td></td>
</tr>
</tbody>
</table>

(After EE)
Resource Changes Impacting Needs

- Coal fleet management
  - Retired FC 1-3 in 2013 (560 MW) in exchange for more efficient larger unit share
  - Cholla 2 retired October 1, 2015 (260 MW)
  - Plan to discontinue burning coal in Units 1&3 by 2025
  - Evaluation of on-going Cholla operations continues
- Ocotillo Modernization Project – 510 MW
  - Planned to be on-line by summer 2019
- Customer-sited micro-grid – 33 MW
  - Initial phase of flexible back-up generation
- Red Rock Solar – 40 MW
  - Solar project at Saguaro plant near Tucson
- All Source RFP for deliveries beginning 2020 – 400 to 600 MW
  - In process of evaluating proposals
# Resource Needs

**PRELIMINARY 2017 IRP (Values in MW at Peak)**

<table>
<thead>
<tr>
<th></th>
<th>2017</th>
<th>2022</th>
<th>2027</th>
<th>2032</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROJECTED LOAD REQUIREMENTS (NEEDS)</td>
<td>8,210</td>
<td>9,748</td>
<td>11,252</td>
<td>12,797</td>
</tr>
<tr>
<td>Reserves (Included in Load Requirements)</td>
<td>974</td>
<td>1,194</td>
<td>1,370</td>
<td>1,557</td>
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<tr>
<td>EXISTING RESOURCES AS OF JANUARY 2016</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>APS-Owned Generation</td>
<td>6,045</td>
<td>5,864</td>
<td>5,475</td>
<td>5,474</td>
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<tr>
<td>Long-Term Contracts</td>
<td>1,489</td>
<td>412</td>
<td>355</td>
<td>342</td>
</tr>
<tr>
<td>Total Existing Resources as of January 2016</td>
<td>7,534</td>
<td>6,277</td>
<td>5,830</td>
<td>5,816</td>
</tr>
<tr>
<td>RESOURCE GAP</td>
<td>(675)</td>
<td>(3,471)</td>
<td>(5,422)</td>
<td>(6,981)</td>
</tr>
<tr>
<td>FUTURE PROJECTED DISTRIBUTED RESOURCES</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy Efficiency (1), (2)</td>
<td>225</td>
<td>629</td>
<td>749</td>
<td>857</td>
</tr>
<tr>
<td>Distributed Energy (1), (2)</td>
<td>30</td>
<td>98</td>
<td>175</td>
<td>250</td>
</tr>
<tr>
<td>Demand Response (3) &amp; Microgrid (4)</td>
<td>32</td>
<td>107</td>
<td>232</td>
<td>357</td>
</tr>
<tr>
<td>Total Future Projected Distributed Resources</td>
<td>287</td>
<td>835</td>
<td>1,156</td>
<td>1,464</td>
</tr>
<tr>
<td>FUTURE PROJECTED UTILITY RESOURCES</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural Gas</td>
<td>363</td>
<td>2,611</td>
<td>4,084</td>
<td>5,229</td>
</tr>
<tr>
<td>Total Future Projected Utility Resources</td>
<td>388</td>
<td>2,672</td>
<td>4,266</td>
<td>5,517</td>
</tr>
<tr>
<td>TOTAL PROJECTED ADDITIONS</td>
<td>675</td>
<td>3,507</td>
<td>5,422</td>
<td>6,981</td>
</tr>
<tr>
<td>TOTAL RESOURCES</td>
<td>8,210</td>
<td>9,784</td>
<td>11,252</td>
<td>12,797</td>
</tr>
</tbody>
</table>
Technologies Being Evaluated for IRP Portfolios

- Flexible demand management
  - Load shifting
  - Demand response / Load management
  - Peak demand reduction
- Energy storage
- Combustion turbines
- Reciprocating engines
- Solar
- Wind
- Coal
- Nuclear
Action Plan Update

- Ocotillo Modernization Project
  - 510 MW project on track for 2019 in-service
  - Steam units planned to be retired at “first-fire”

- Coal Fleet Management
  - Cholla 2 retired October 1, 2015 – 260 MW
  - Evaluation regarding remaining Cholla Units 1&3
  - Upcoming decisions on Navajo Generation Station – 315 MW APS Share
  - Four Corners SCR installation begins Fall 2017

- Solar Partner Program
  - Installing West facing solar on customer homes
  - Better alignment with customer peak demand
  - Installation of 4 MWh of battery storage planned completion by end of 2016

- Solar Innovation Study
  - 75 home study, separated into three segments
  - Segments have differing combinations of: solar PV, smart inverter, HEM/load control, variable speed HVAC, energy storage
Action Plan Update

• Microgrid
  - Installing customer sited back up generation for Marine Corp Air Station in Yuma and Aligned Energy in Phoenix
  - Approximately 33 MW combined of generation for initial phase by end of 2016
  - Benefits all customers by providing reserves and peak demand contribution

• Red Rock Solar
  - Large customers desiring “green” attributes
  - Constructing 40 MW SAT solar pv project at Saguaro Power Plant

• Energy Imbalance Market (EIM)
  - Integration of variable energy resources
  - Cost savings for customers through coordinated dispatch over large geographic area
  - On schedule for “go live” in October 2016

• Resource Procurement / Development
  - All-source RFP Issued in March of 2016 for 400 – 600 MW
    • Deliveries requested to begin 2020
  - Short term market purchases to meet near term needs
  - Beginning initial site planning for post 2020 resource needs
Portfolio Analysis

Coal Strategy
Evaluates early retirement of Cholla Units 1 and 3 and NGS, executes Four Corners strategy

Carbon Reduction
Evaluates carbon reduction beyond potential CPP requirements

Energy Storage Systems
Incorporates greater penetration of ESS to further integrate renewables and help manage peak demand

Small Modular Reactors
Incorporates new nuclear technology of small modular reactors to reduce carbon footprint and provide baseload power

Expanded Renewables
Increases renewable energy portfolio contribution beyond requirements of the RES (to include both distributed and grid-scale renewable energy resources)

Expanded Demand Side Management
Increases contribution of distributed energy resource solutions such as energy efficiency, demand response, battery storage, smart inverters and other technologies
Scenario and Sensitivity Analysis Considerations

- Both scenario and sensitivity analyses were performed in APS’s 2014 IRP
- In order to provide the highest value and avoid speculative assumptions regarding the correlation of variables within scenarios, APS recommends only performing sensitivity analysis in the 2017 IRP
- Sensitivities should include
  - Natural gas pricing, CO2 pricing, load forecast, resource costs
IRP Filing Process Considerations

- APS is supportive of 3-year IRP cycle
  - Provides ample opportunities for dialogue on important issues
    - Preliminary IRP’s provide high-level discussion on key items
    - Action Plan updates as items change
    - Workshops facilitate dialogue
Flexibility
Key to Providing Reliable, Affordable Electricity for Our Customers

CUSTOMER RESOURCES
Provide additional tools for customers to better manage peak demand

RATE DESIGN
Align price signals with resource needs and costs

OPERATIONAL AGILITY
Add fast-starting, fast-ramping resources to meet peak demand and integrate renewables