APS Peak Demand and Energy Forecast

February 15, 2008
Objective

- Describe APS outlook for electricity demand through 2027
- Focus on key assumptions driving the outlook
- Explain the APS forecast methodology
Forecast Trends

- Peak Demand and Energy Grow Substantially Over the Next 20 Years
- Population Growth Fed by Continued Net In-migration is the Largest Single Source of Growth
- Energy Usage Trends Depend Greatly on Segment Type; Modeled Accordingly
- Naturally-occurring Efficiency Gains Offset Some of the Growth
Forecast for 2027

- System Peak Demand Grows to 12,772 MW (7,100 MW in 2007)
  - Before Energy Efficiency and Distributed Energy Program Impacts
  - 3.0% AGR, 280 MW per year
- Energy Consumption Grows to 55,000 gWh from 31,000 in 2007
- Arizona Population Reaches 9.8 million from 6.2 in 2007
- Retail Customers Increase to 1.85 million from 1.1 million in 2007
Annual System Peak Load (MW)
Weather Normalized

- Own Load
Load Growth Drivers

Weather Normalized

[Graph showing energy due to customer growth and other factors from 2000 to 2026]
## Peak Forecast (MW)

**Before DSM & DE**

<table>
<thead>
<tr>
<th></th>
<th>2008</th>
<th>2012</th>
<th>2017</th>
<th>2027</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>3,504</td>
<td>4,068</td>
<td>4,831</td>
<td>6,595</td>
</tr>
<tr>
<td>Small C&amp;I</td>
<td>2,523</td>
<td>2,906</td>
<td>3,371</td>
<td>4,378</td>
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<tr>
<td>Large C&amp;I</td>
<td>388</td>
<td>388</td>
<td>388</td>
<td>388</td>
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<tr>
<td>Irrg. &amp; Stlights</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Line Losses</td>
<td>758</td>
<td>868</td>
<td>1,012</td>
<td>1,335</td>
</tr>
<tr>
<td>Traditional Wholesale</td>
<td>67</td>
<td>68</td>
<td>70</td>
<td>72</td>
</tr>
<tr>
<td>Own Load</td>
<td>7,247</td>
<td>8,304</td>
<td>9,676</td>
<td>12,772</td>
</tr>
</tbody>
</table>
Components of Forecast

- Customers
- Use per customer
- Losses
- Load Factor
- Wholesale contracts
# Peak and Energy Growth

<table>
<thead>
<tr>
<th></th>
<th>‘08 to ‘12</th>
<th>‘08 to ‘17</th>
<th>‘08 to ‘27</th>
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</thead>
<tbody>
<tr>
<td>System Peak Demand</td>
<td>3.2%</td>
<td>3.2%</td>
<td>3.0%</td>
</tr>
<tr>
<td>Own Load Energy</td>
<td>3.1%</td>
<td>3.0%</td>
<td>2.8%</td>
</tr>
<tr>
<td>Retail Customers</td>
<td>3.2%</td>
<td>3.1%</td>
<td>2.7%</td>
</tr>
<tr>
<td>Use per Customer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Residential</td>
<td>0.7%</td>
<td>0.6%</td>
<td>0.7%</td>
</tr>
<tr>
<td>- C&amp;I &lt; 3 mW</td>
<td>0.0%</td>
<td>0.1%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Population (Arizona)</td>
<td>2.7%</td>
<td>2.5%</td>
<td>2.1%</td>
</tr>
<tr>
<td>- Net Migration</td>
<td>1.9%</td>
<td>1.7%</td>
<td>1.3%</td>
</tr>
<tr>
<td>- Natural Increase</td>
<td>0.8%</td>
<td>0.8%</td>
<td>0.8%</td>
</tr>
</tbody>
</table>
Customer Forecast

- Residential Customers Derived From:
  - Population x Persons Per Household x APS Territory Share
- Business Customers Follow Residential Growth
- Arizona Population Forecast
  - Most Important Factor in Customer Growth
  - Migration, Net Natural Increase
- Persons Per Household
  - Critical for Residential Customer Forecast
  - Historic Householder Rates by Age Cohort
- APS Territory Share
  - Driven by Historic Share, Known Building Patterns
Residential Customers

![Yr over Yr Growth Rate](chart)

- Actuals
- Forecast
Population/Household Forecast

- Net migration remains significant but slowing
  - Business cycle volatility likely, but long-term fundamentals positive
  - Consistent with external forecasters
- Natural increase stable and predictable
- Persons per household continues to decline as population ages
Arizona Population Growth

APS Projections by Component

Net Natural Increase

Net Migration
Arizona Householder Rates by Age

Note: The householder rate is the share of an age group that heads a household.
Population Shares by Age

- 14 years and under
- 15 to 24 years
- 35 to 44 years
- 65 years and over
Residential Use per Customer

- Use per Customer Continues to Grow
  - 0.7% 2008 to 2027
  - 1.0% 1980 – 2007 (Weather Normalized)

- Principal Drivers
  - Home size for new customers
  - More household electronics
  - Increasing desert share

- Naturally-occurring efficiency offsets growth (partially)
Residential Usage Forecast

- Residential End Use Model
  - 5 End Uses + Base
  - Appliance Saturation by End Use
    - Historical Estimates Trended
    - Estimated From Survey of 3,000 Households Every 3-4 Years (most recently in 2005)
  - Electricity vs Natural Gas Share
    - Trended & existing building practices
  - Appliance Efficiency
    - Federal Efficiency Standards, Current Sales, Installations
    - Naturally Occurring Efficiency Upgrades Without DSM Incentives (New Customers and Appliance Replacements)
  - Total Household Usage = Sum of End Uses
Residential Usage Growth
Commercial & Industrial Use per Customer

- C&I Use per Customer Declining Modestly
  - -0.1% per year 2008 – 2027
  - -0.2% per year 1980 – 2007 (weather normalized)

- Principal drivers are mix of business segments
  - Faster customer growth in less energy-intensive segments

- Methodology
  - Small C&I (< 3 mW) segmented into 10 building types
  - Large C&I (> 3 mW) projected individually
Small C&I Sales Important Factors

- 10 Building Types or “Segments” are Very Different in Size and Usage Behavior
- Usage Within Building Types Observed To Be Very Stable
- Mixture of Building Types is Primary Cause of Usage Change over Time
Small C&I Customers by Segment
Small C&I Use per Customer by Segment

- Office
- Other
- Manufacturing
- Retail
- School
- Grocery
- Restaurant
- Hospital
- Hotel
- Warehouse
- Total

mWh/customer

- 2000
- 2008
- 2017
- 2027
Large Customer Forecasts

- Large C&I Accounts ( > 3MW ) Forecast Individually From Historic IDR data
- Each Large Customer is Unique
  - Weather Sensitivity
  - Business Cycle Vulnerability
  - Industrial Classification
- Wholesale Accounts Forecast Individually
System Peak Forecast

- Sum of Class Peaks
  - Residential
  - Small C&I
  - Large C&I (Individually for 90 Accounts)
  - Irrigation
  - Line Losses (11.7%)
  - Wholesale (Individually for 13 Contracts)
Shaping

- **Monthly Shape Via 5 Year Average**
  - Monthly Load Factor
  - Monthly Peak Ratio

- **Daily & Hourly Shape Via an Historic Pattern**
  - Daily Energy = f(Daily Weather, Day of Week)
    - Daily Weather from 10 Year Sampling Method
    - Ensures Correct Range of Daily Weather for Each Month
  - Hourly Load MW = f(Daily Energy, Temp)
    - 48 Models (24 winter, 24 summer)
Daily Average Temperature Forecast

TMY Forecast

Last Year Actual
Load Duration for 2008