

Power Task Force Agenda Number 3.

Wholesale Energy Markets in the West

Brad Albert – GM Resource Management

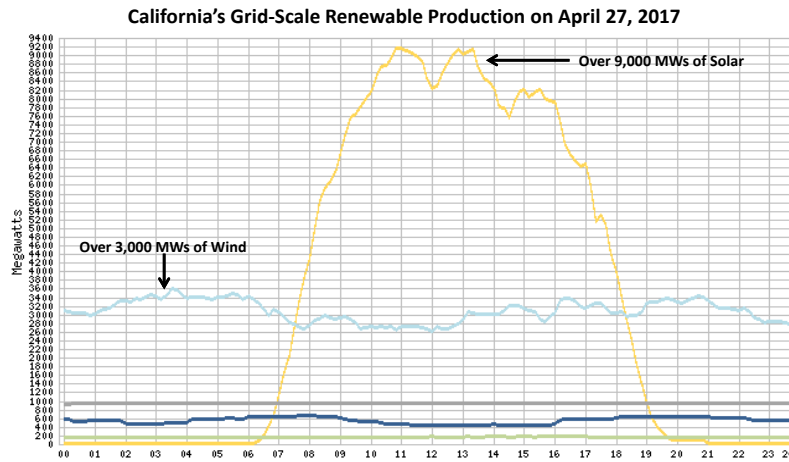
May 18, 2017



A Major Evolution is Underway!

- The power supply portfolio in the west is changing rapidly due to:
 - Renewable energy policies
 - Customer desire for green energy
 - Large customers seeking “additionality”
 - Rooftop solar supported by net metering and tariff policies
 - Relatively low natural gas prices
 - Driven by horizontal drilling and hydraulic fracturing technologies
- Just some of the consequences:
 - Low (and even negative) wholesale power prices
 - Merchant natural gas generators struggling to remain viable
 - The need for baseload power sources changes as customer demand patterns change and relatively inflexible renewable generation is added

The Magnitude is Staggering



About 13,000 MWs grid-scale renewables across the middle of the day
(This doesn't include another 5,000+ MWs of rooftop solar)

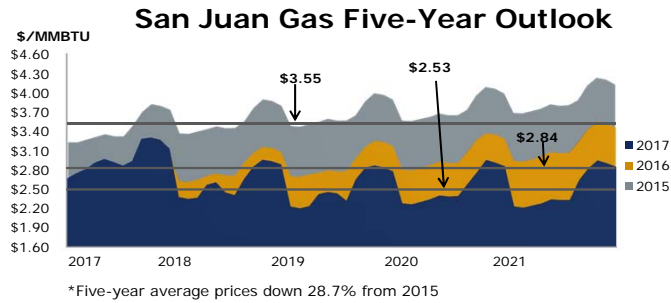
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Solar Resource Growth

- California - Renewable Portfolio Standard 50% energy production by 2030
 - Rooftop solar is in addition
 - Utility scale solar currently near 10,000 MWs
 - Community Choice Aggregation programs
 - Customer driven to show they are "Green" - Google, Microsoft, Universities, etc.
- APS
 - Utility scale solar - 530 MWs
 - Rooftop solar is over 600 MWs and growing at 10-15 MWs per month

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Natural Gas – Market Outlook



- Long-term, stable outlook
- Large, high-efficiency natural gas combined cycle generators produce at approximately 25 \$/MWH

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APS' Participation in Wholesale Energy Markets

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Arizona Public Service Co.

▶ Largest utility in Arizona

- ▶ 1.1 million customer accounts
- ▶ 34,646 square miles

▶ Scope of Energy Delivery

- ▶ 28,000 distribution miles
- ▶ 5,300 transmission miles
- ▶ 410 substations

▶ Resources

- ▶ 9,000 MW total capacity
- ▶ Peak demand – 7,100 MW

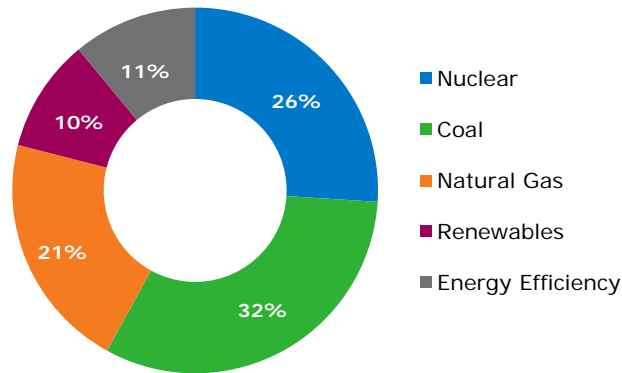


APS Retail Service Territory

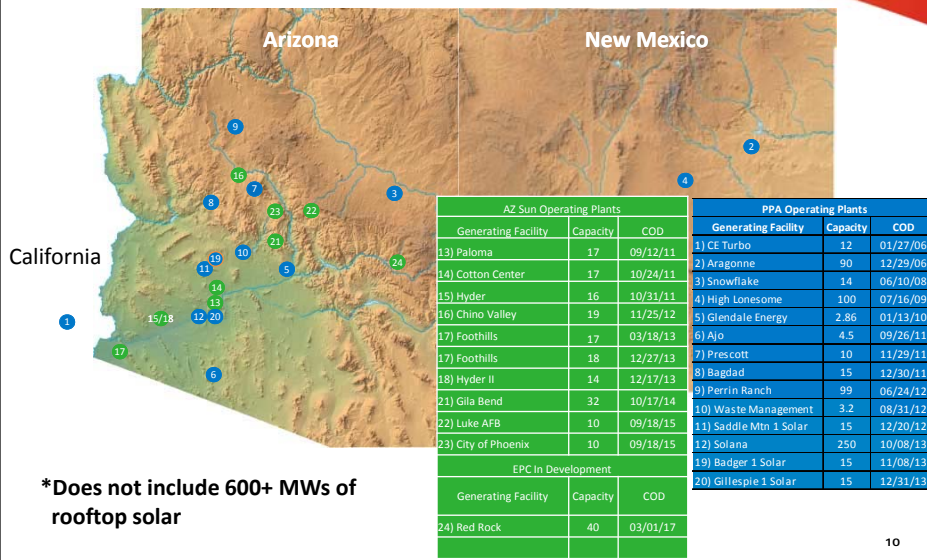
Five Major Categories of Resources

<p>Nuclear</p> <ul style="list-style-type: none"> • Palo Verde 	<ul style="list-style-type: none"> • Reliable source of carbon-free around-the-clock power • Lowest operating cost 	<p>1,146 MWs</p>
<p>Coal</p> <ul style="list-style-type: none"> • Four Corners • Cholla • Navajo 	<ul style="list-style-type: none"> • Affordable source of around-the-clock power • Relatively expensive and time consuming to start/stop 	<p>1,672 MWs</p>
<p>Natural Gas Intermediate Units</p> <ul style="list-style-type: none"> • Redhawk, Gila River, Arlington • West Phoenix Units 1-5 • Ocotillo Steamers 	<ul style="list-style-type: none"> • Large, high efficiency units, with longer ramps and longer minimum up and down times • Reliable and Flexible to System Demands 	<p>3,151 MWs</p>
<p>Natural Gas Peaking Units</p> <ul style="list-style-type: none"> • Sundance • Yucca • West Phoenix, Saguaro, and Ocotillo GTs 	<ul style="list-style-type: none"> • Small, less efficient units, quick start that can be online in 10-30 minutes • Very flexible 	<p>1,017 MWs</p>
<p>Renewables (utility-scale)</p> <ul style="list-style-type: none"> • Wind • Solar 	<ul style="list-style-type: none"> • Clean source of energy with low long-term costs • Inflexible, must take energy as it is produced (non-dispatchable) 	<p>855 MWs</p>

2016 - Well Balanced Energy Portfolio



855 MWs of Grid-Scale Renewables



APS' Philosophy on Energy Markets

- Our participation in energy markets is a means to an end:
 - APS is not a trading company!
 - We participate in energy markets to serve our customers better:
 - Improve cost effectiveness and reliability
 - Promote price stability
 - We also believe in using all of the tools in the toolbox:
 - Participation in the Western EIM
 - Creation of a “trough hours” trading product

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Extensive Participation in Energy Markets

- 3-year rolling commodity hedge program:
 - Hedge energy price risk
 - Primarily natural gas prices
 - Conducted through OTC swap contracts and physical commodity
- Optimization of energy supply:
 - This activity is continuously happening
 - Seek to minimize net cost of meeting our customer's needs
 - Buy/sell in all electricity markets:
 - Real-time (hourly), day-ahead, term
 - Participating in the Western Energy Imbalance Market (EIM)
 - EIM is a 5-minute dispatch optimization
 - APS started participating in October, 2016

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Risk Management Infrastructure

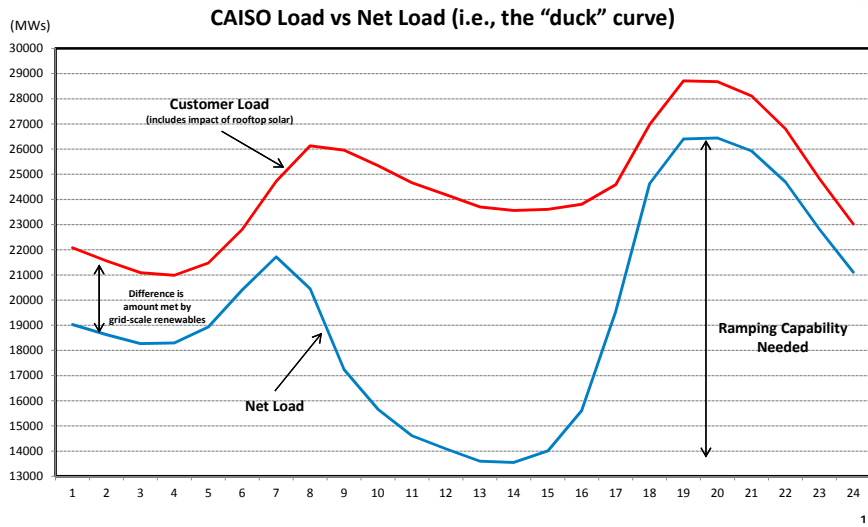
- Clearly Defined Policies:
 - Commodity hedge policy
 - Energy risk management guidelines
 - Credit risk
- Independent Oversight of Trading Activities:
 - Risk Management and Back Office organizations
 - Report thru a different part of organization
 - Oversight committees with diverse representation
 - Energy Risk Oversight Group
 - Executive Risk Committee
 - Established processes for vetting/approving non-standard deals
 - Active credit risk management organization
- Routine Reporting and Monitoring
 - Risk reporting infrastructure in place

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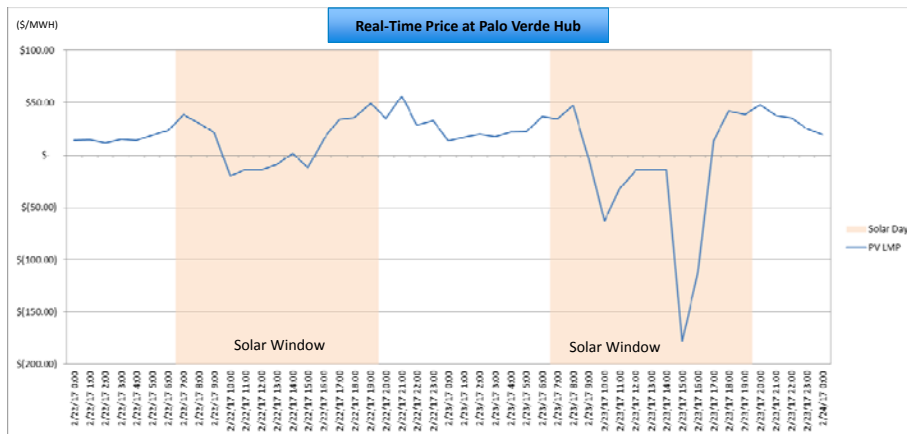
Where are Wholesale Electricity Markets Going?

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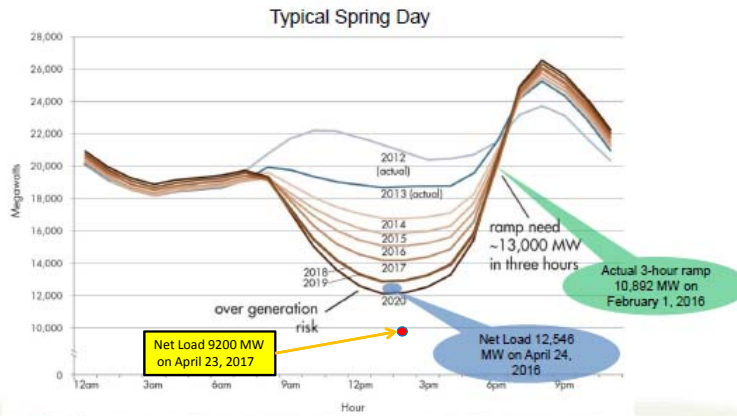
California Load on February 23, 2017



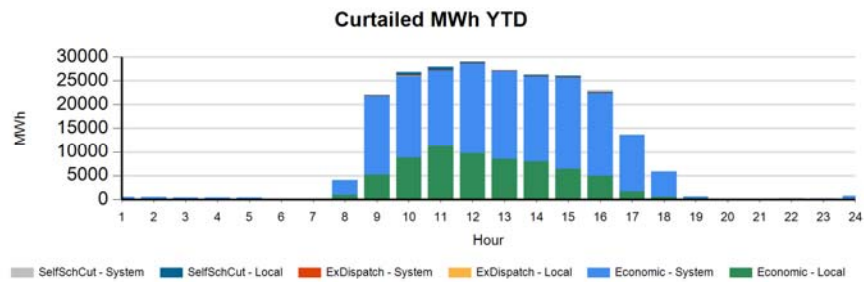
A Closer Look at February 22nd & 23rd



CAISO Future Load Shape



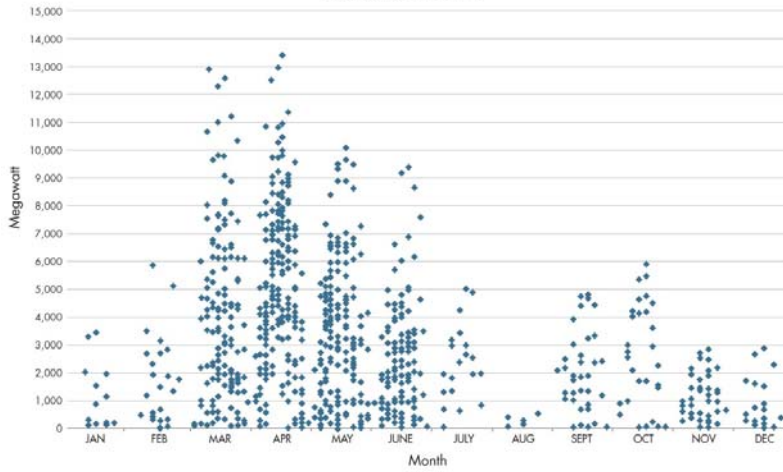
.... And Substantial Amounts of Renewable Energy Being Curtailed in California



- This chart shows CAISO Year to date (2017) curtailed renewable MWhs thru April 27th

Projected Renewable Curtailment in California

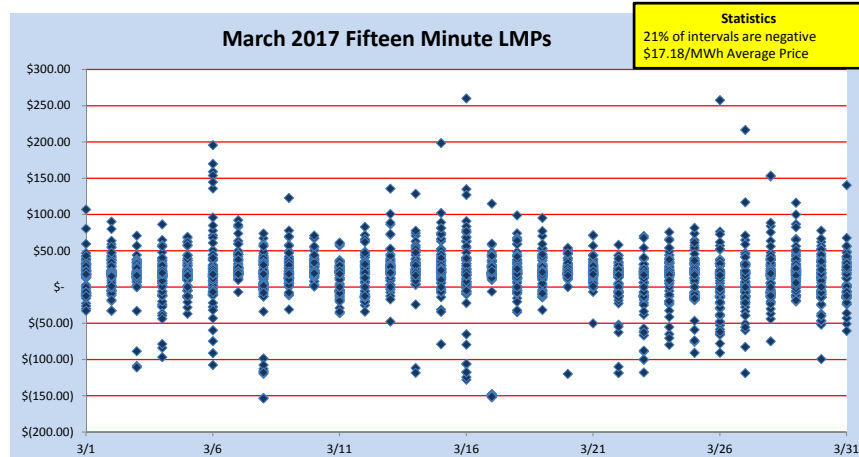
40% RPS in 2024



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Negative Prices Occurred on Nearly Every Day in March, 2017



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**Thank You for the Opportunity
to Speak to You Today!**