Flexibility for the Future

Integrated Resource Planning Workshop

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Agenda

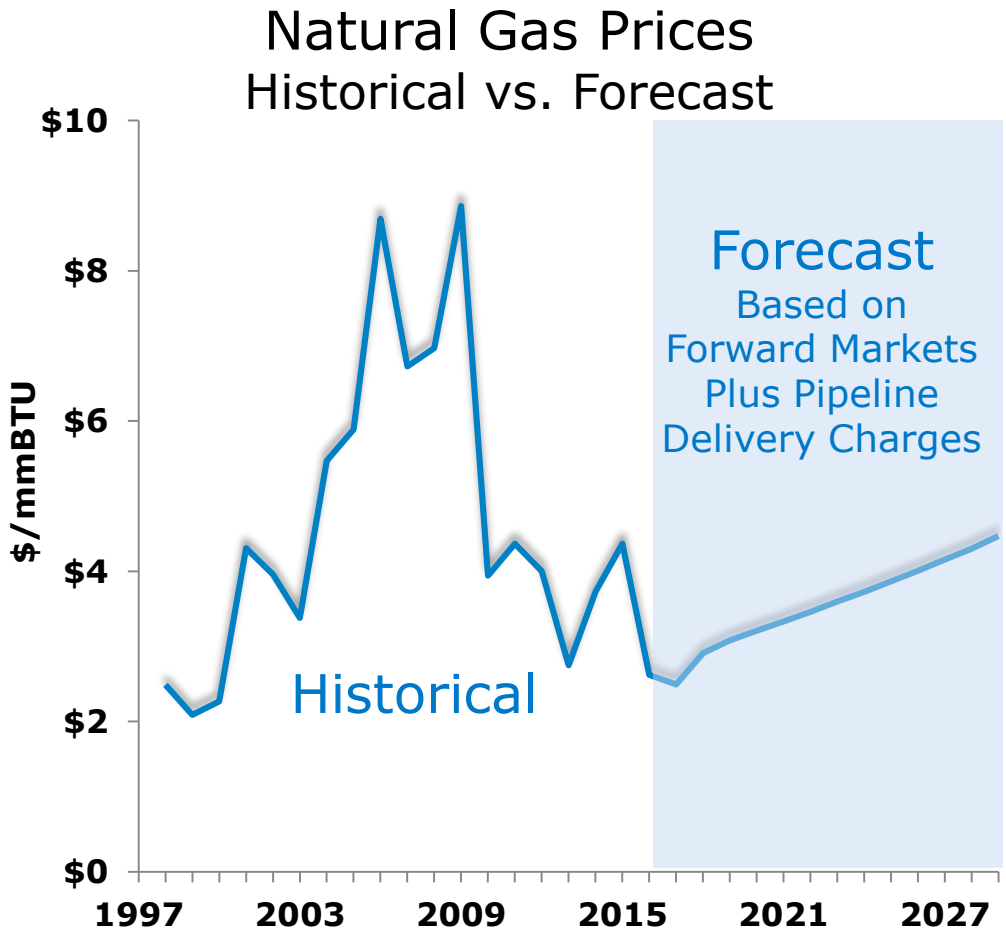
- Key Planning Drivers
- Evolving Load Patterns and Markets
- Forecasting
- Resource Needs
- Technologies Being Evaluated
- Customer Resources – Flexible Demand Management
- Action Plan Update
- Portfolios and Sensitivities
- IRP Process Considerations

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

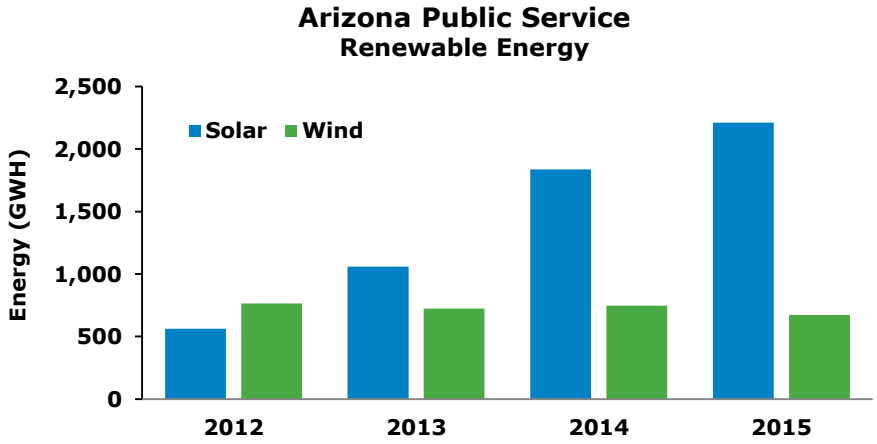


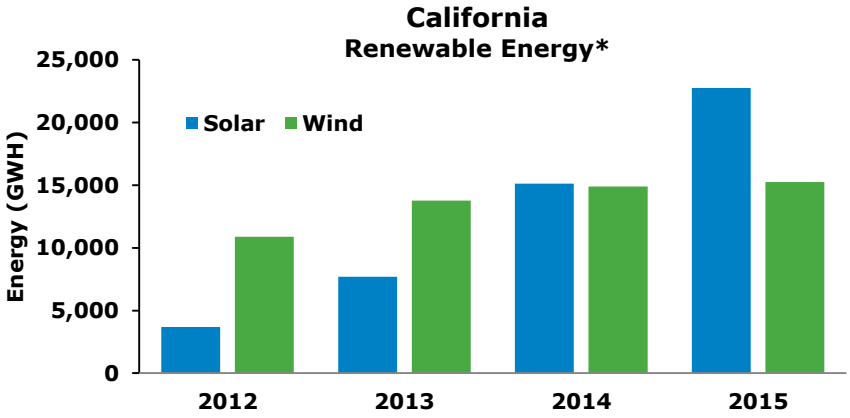
Cost of Environmental Regulations

- 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

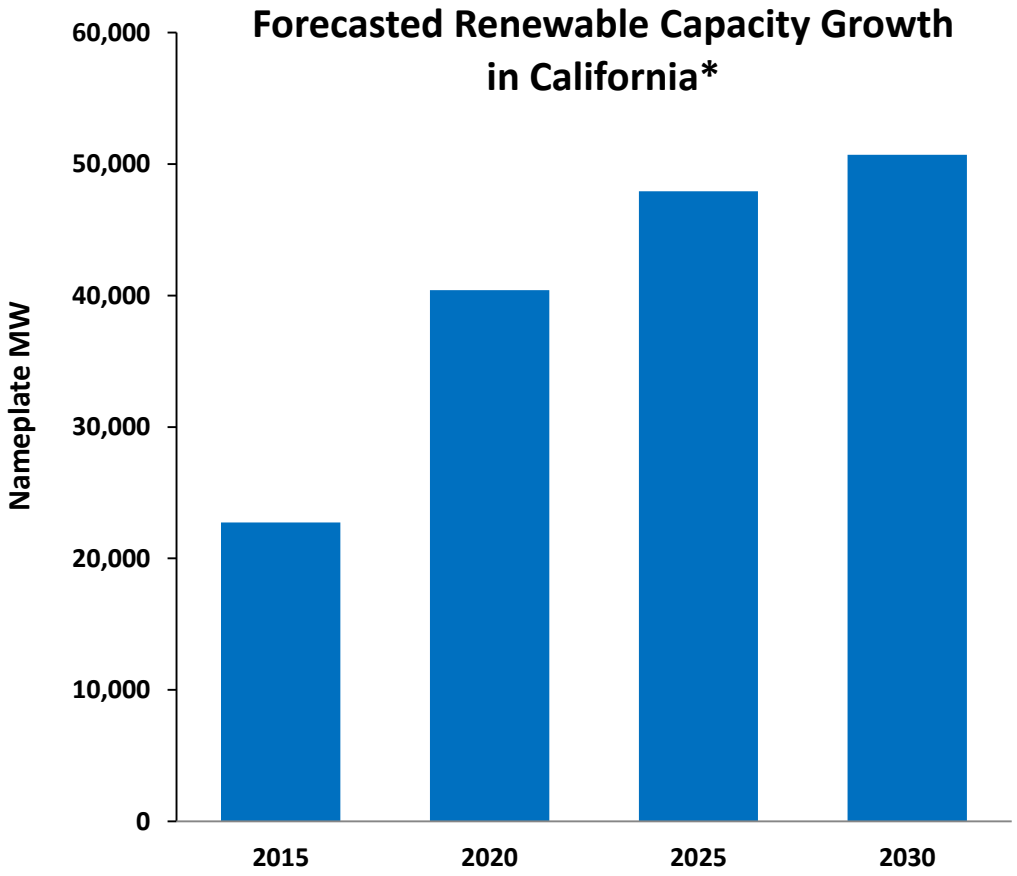
- Renewable production on the APS system has increased from 1,350 GWH's in 2012 to over 3,000 GWH's today
- Solar and wind production in CAISO has grown from 14,000 GWH's in 2012 to about 40,000 GWH's today





*Source: on IHS Report "North America Renewable Power Market Forecast, 2016–30"

Growth in Installed Capacity Expected to Continue

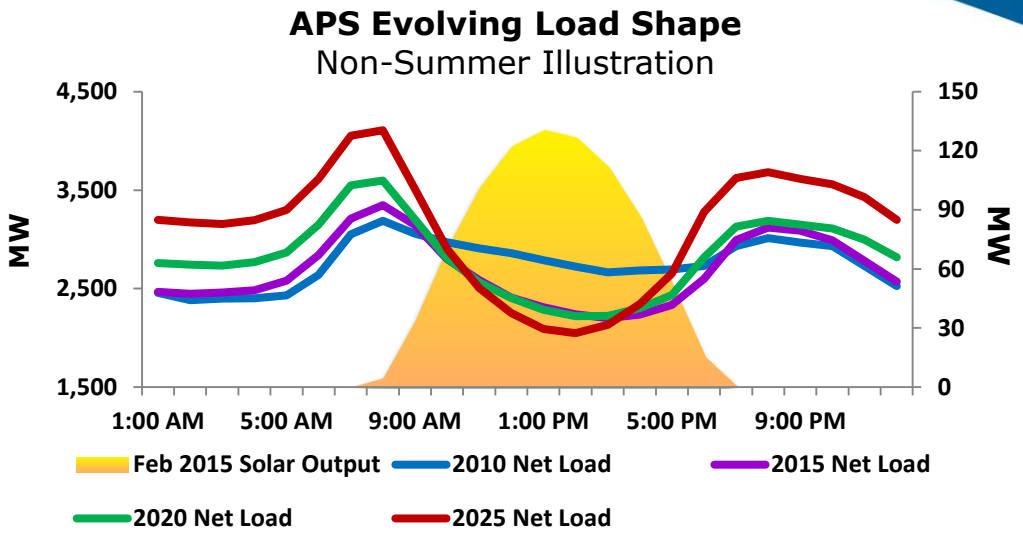


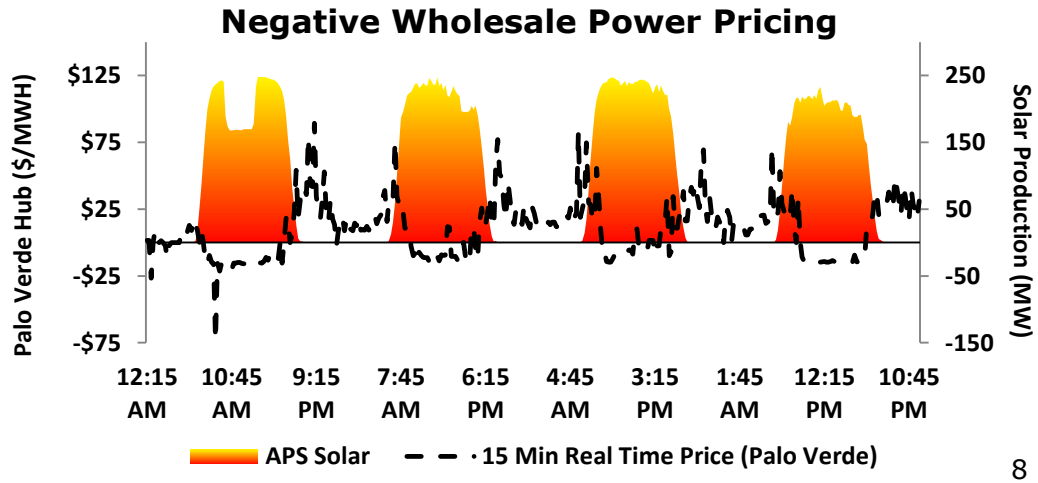
- California RPS increased to 50% by 2030
- Solar forecasted to be roughly 70% of installed renewable capacity

*Source: on IHS Report "North America Renewable Power Market Forecast, 2016–30"

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

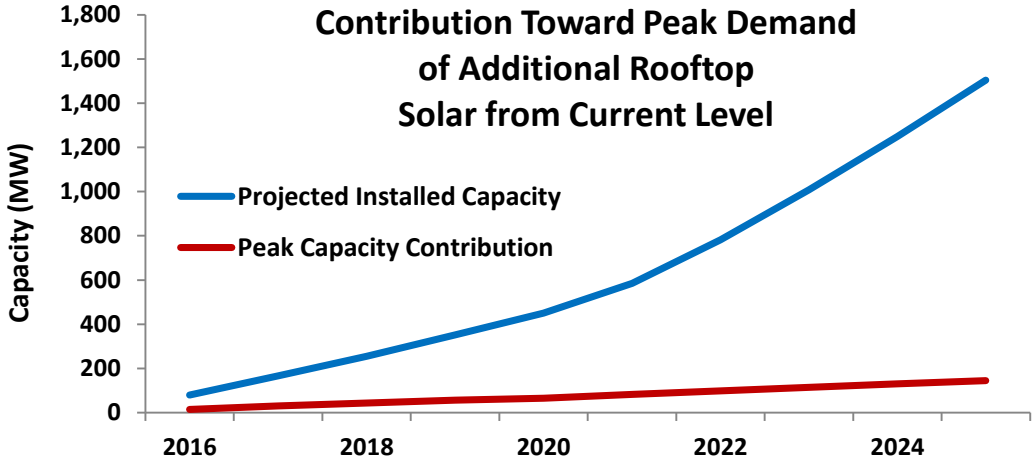


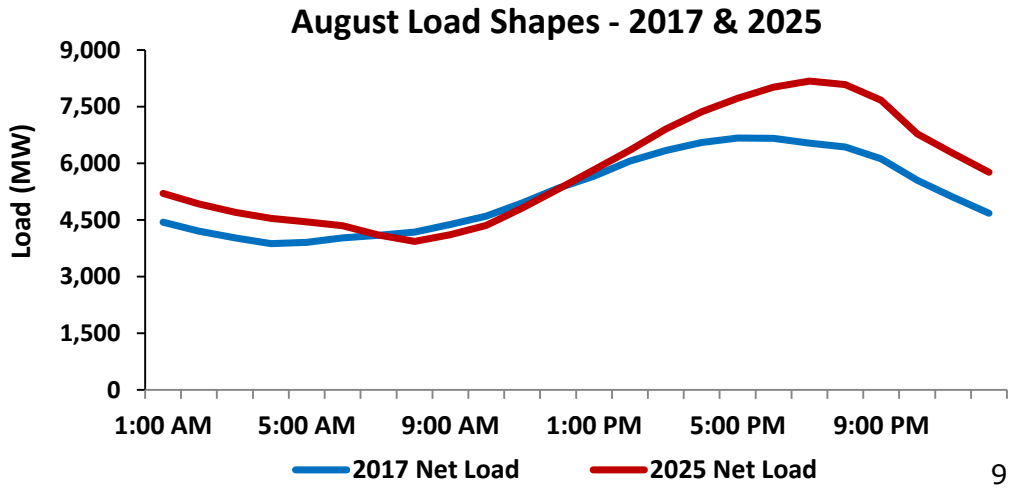


* Source: http://oasis.caiso.com/mrioasis/logon.do

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

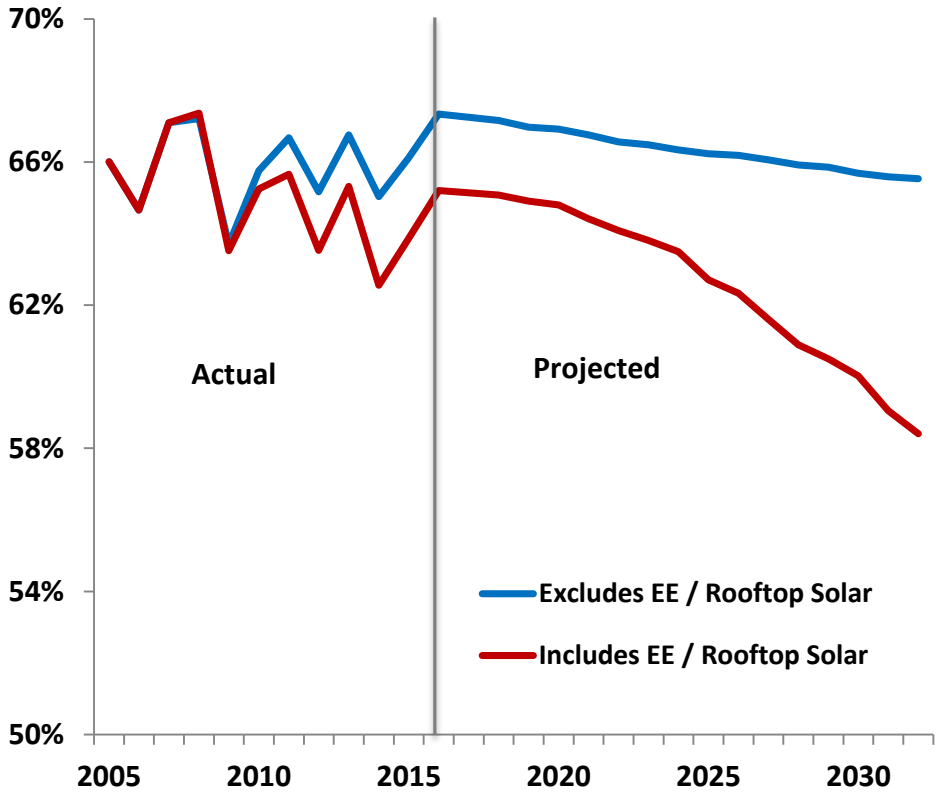




Summer System Load Factor

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%

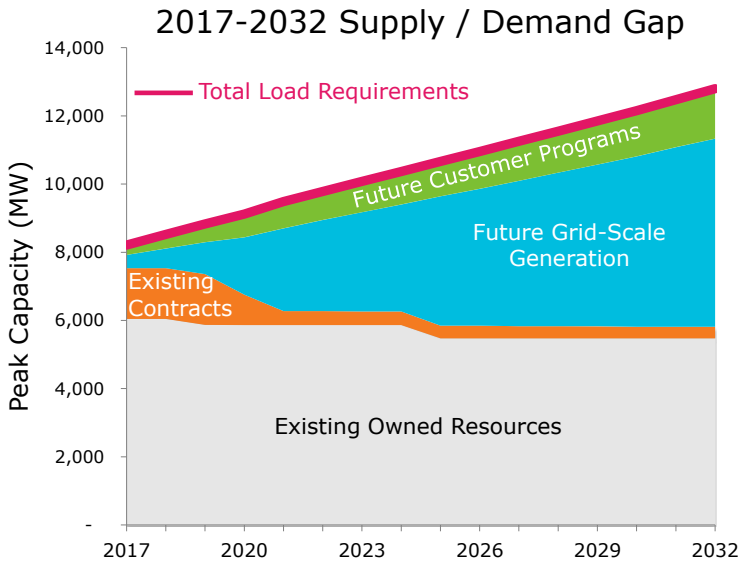
Existing Resources

Capacity By Type for Year 2016

	Nameplate	On Peak	Peak Need
Nuclear	1,146	1,146	
Coal	1,672	1,672	
Gas/Oil Owned	3,106	3,106	
Solar Owned	524	430	
Wind	283	55	
Geo / Biomass / Landfill	29	29	
Purchases	1,911	1,911	
Rooftop Solar (additional)	79	14	
Energy Efficiency (additional)	109	109	
Total	**8,859**	**8,472**	**7,940** (After EE)
Existing Rooftop Solar	490	161	

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

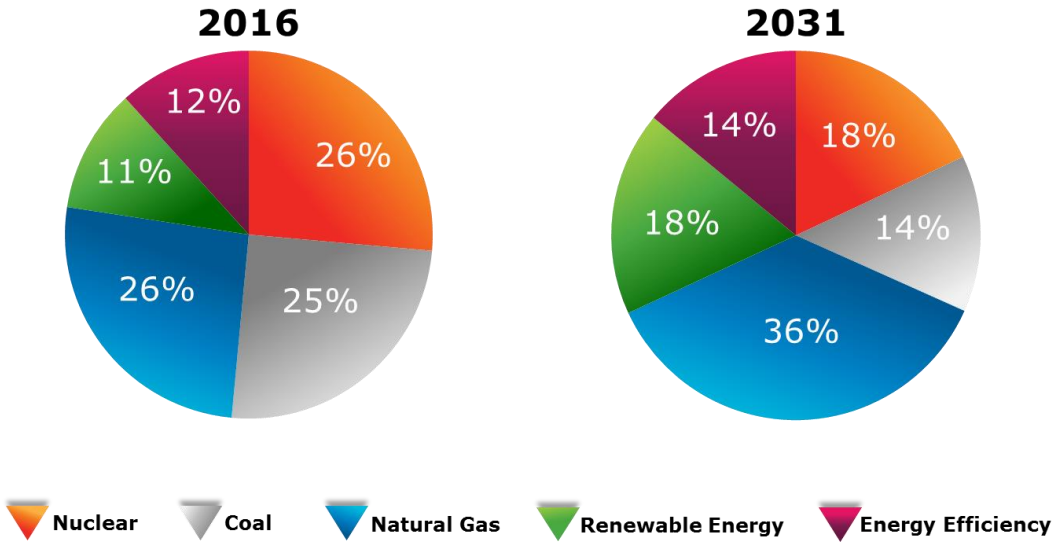


Resource Needs

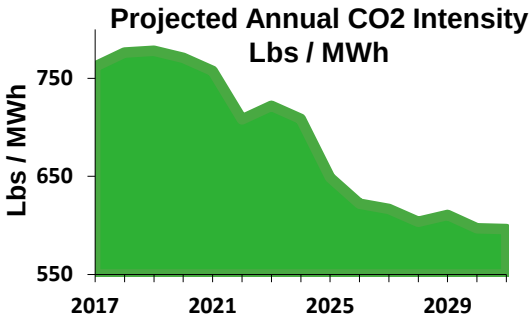
PRELIMINARY 2017 IRP (Values in MW at Peak)	2017	2022	2027	2032
PROJECTED LOAD REQUIREMENTS (NEEDS)	8,210	9,748	11,252	12,797
Reserves (included in Load Requirements)	974	1,194	1,370	1,557
EXISTING RESOURCES AS OF JANUARY 2016				
APS-Owned Generation	6,045	5,864	5,475	5,474
Long-Term Contracts	1,489	412	355	342
Total Existing Resources as of January 2016	7,534	6,277	5,830	5,816
RESOURCE GAP	(675)	(3,471)	(5,422)	(6,981)
FUTURE PROJECTED DISTRIBUTED RESOURCES				
Energy Efficiency (1), (2)	225	629	749	857
Distributed Energy (1), (2)	30	98	175	250
Demand Response (3) & Microgrid (4)	32	107	232	357
Total Future Projected Distributed Resources	287	835	1,156	1,464
FUTURE PROJECTED UTILITY RESOURCES				
Natural Gas	363	2,611	4,084	5,229
Renewable Energy & Energy Storage	25	62	182	288
Total Future Projected Utility Resources	388	2,672	4,266	5,517
TOTAL PROJECTED ADDITIONS	675	3,507	5,422	6,981
TOTAL RESOURCES	8,210	9,784	11,252	12,797

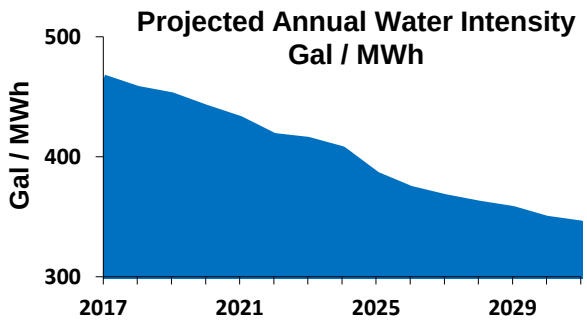
Sustainable Planning

Diverse Energy Mix



Improving Environmental Attributes





Key Drivers to a Less Carbon-Intensive Portfolio

- Palo Verde Nuclear Generating Station
- Low natural gas prices
- Coal fleet management
- Renewable energy
- Energy efficiency

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 Variables and Sensitivities

PORTFOLIO VARIABLES

Natural Gas

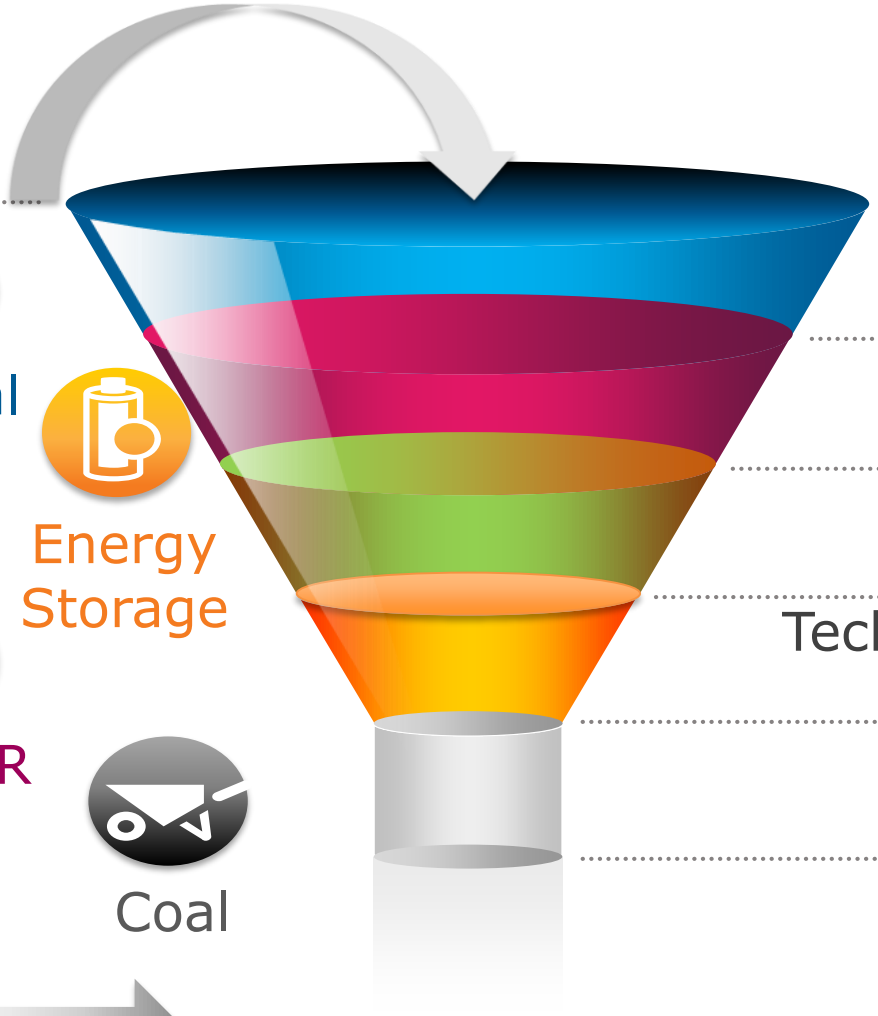
Renewable Energy

Energy Storage

EE / DR

Nuclear

Coal



INPUT VARIABLES

Natural Gas Prices

CO2 Prices

Load Forecast

Technology Capital Costs

Other?

Low — Level of Penetration — High

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

OPERATIONAL AGILITY

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

RATE DESIGN

Align price signals with resource needs and costs

CUSTOMER RESOURCES

Provide additional tools for customers to better manage peak demand

www.aps.com/resources

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