

Predictive Gas Management

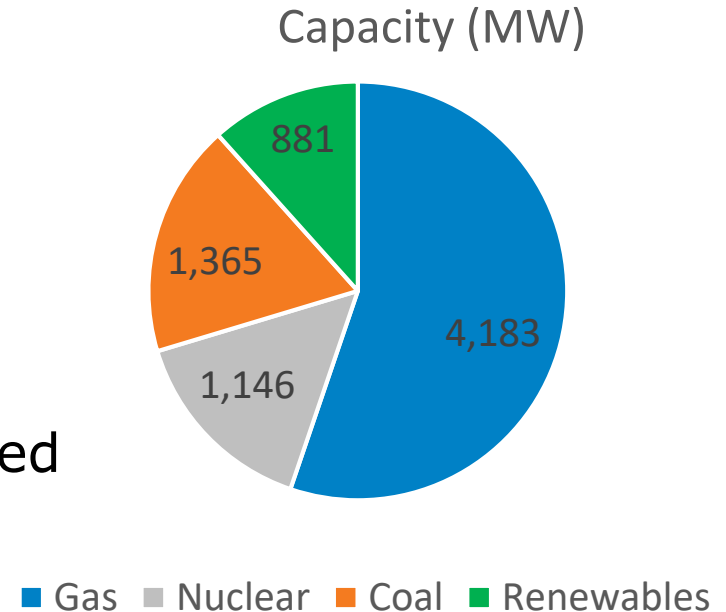
Western EIM Regional Issues Forum

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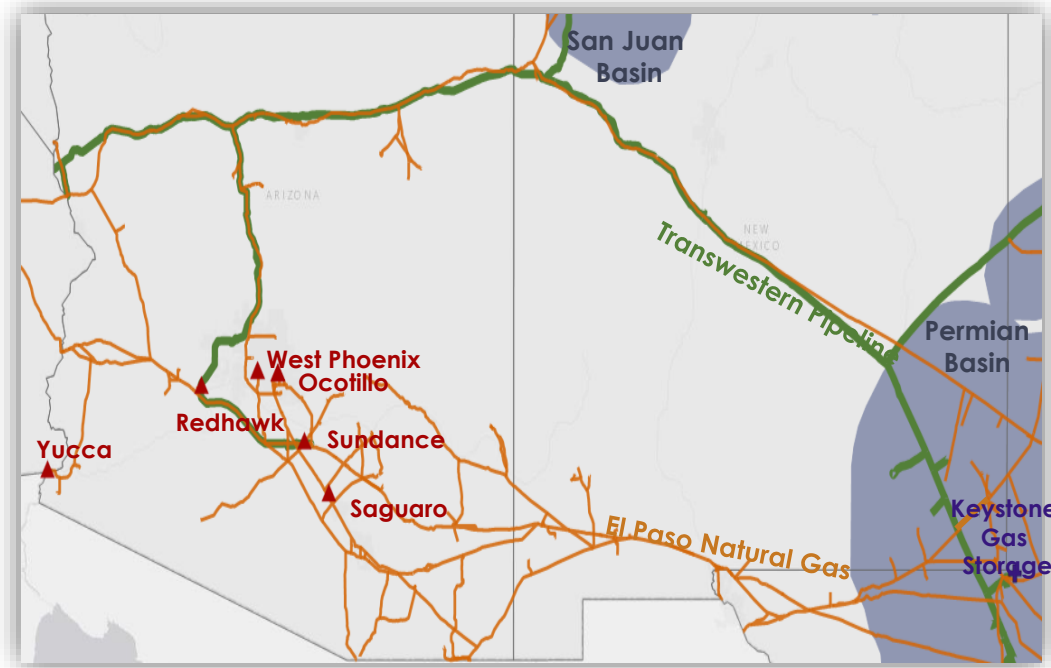
Gas Management Important for APS

- APS resource mix 55% natural gas
- APS system balanced with gas
- Must manage daily and hourly pipeline contractual flow limits
- Intra-day flexible options very limited
 - No local gas storage
 - No hydro resources
 - Battery storage planned

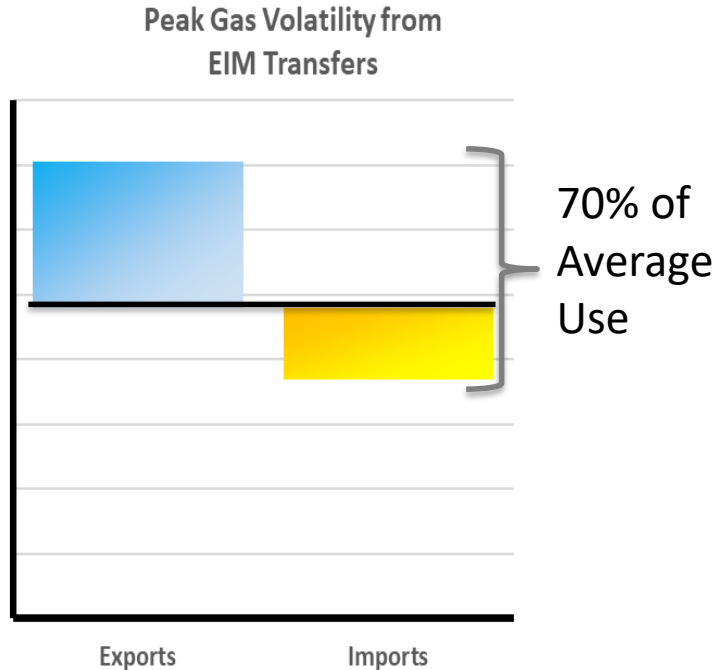


Gas Delivery Complicated Pre-EIM

- Delivery on Transwestern and El Paso pipelines from distant basins
- Some generation has dual pipeline connection
- Distant storage must be scheduled on pipeline
- Pipelines close to full capacity
 - Requires day ahead schedules for delivery certainty
 - Intraday schedules likely to be cut



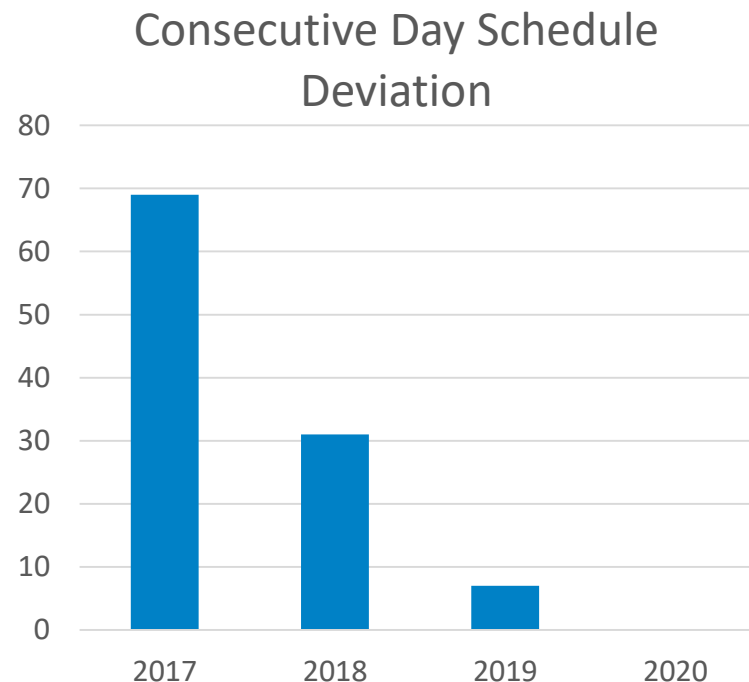
EIM Transfers Increase Daily Gas Volatility



- APS recognizes significant volatility in daily gas usage due to EIM transfers
- EIM optimization tends to increase efficient combined cycle production for exports
- Price volatility dispatches higher heat rate turbines much more than we originally expected
- Less impact on the import side due to
 - Lower range of price impact on downside
 - EIM optimization doesn't avoid base scheduled unit starts

Gas Pipelines Important for Electric Reliability

- Electric reliability in Southwest based on gas deliverability
- Utilities leaning on the pipeline to serve unplanned EIM transfers increases overall risk
 - For pipeline operations
 - Ultimately for the utility
- Utilities with significant gas usage volatility must manage this risk
 - Ensure visibility to schedule deviation
 - Put solutions in place to manage pipeline impact



Lessons Learned

- Predictive timely (day ahead) gas purchases
 - Model base resource plan gas burns
 - Adjust for estimated EIM exports/imports
 - Have a plan for managing EIM transfer deviations from forecast
- Hourly management within the day
 - Consistently forecast the balance-of-gas-day
 - Switch generator usage between pipelines to reduce schedule impact to single pipeline
 - Intraday gas transactions
 - Manage EIM transitions of large MSG (gas combined cycle)
 - EIM bid mitigation to control gas burns

Thank You

