



ICForecast: Strategic Power Outlook

Q1 2015 - Sample



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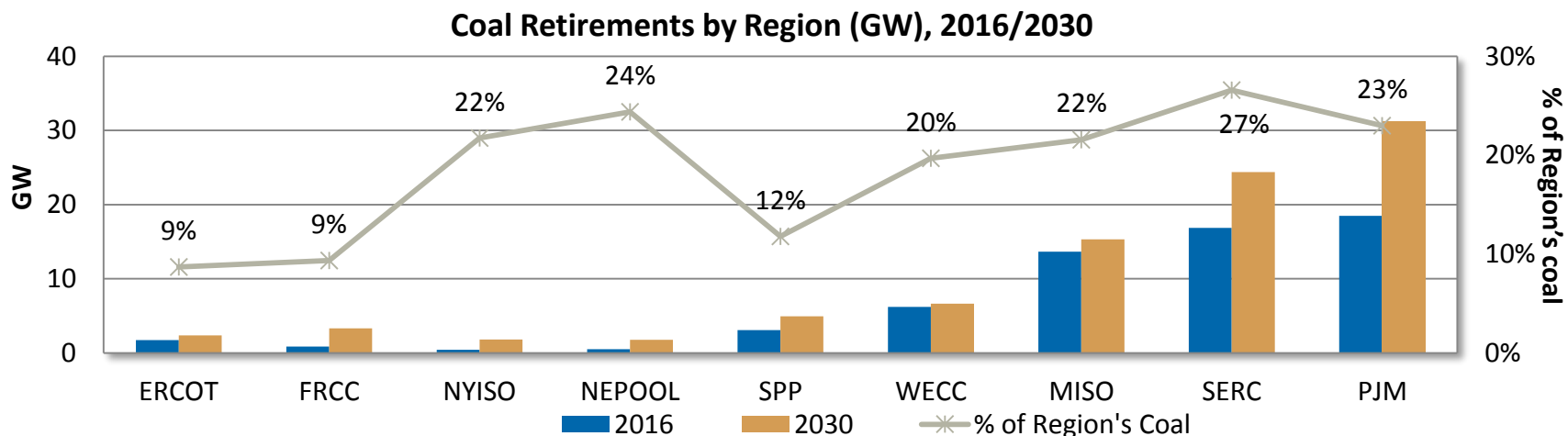


Power Markets

In Focus – Regulations and low gas prices continue to drive coal retirements



- In addition to nearly 10 GW of coal capacity that retired in 2013 and 2014, ICF projects another 62 GW of coal unit retirements between 2015 and 2016 (including those ICF considers firmly planned) due to MATS regulation, low gas prices, low demand growth in some regions, and the future impacts of CO₂ regulation
 - Increasing CO₂ allowance prices over time along with the assumed CAIR II and compliance costs for coal ash and water intake rules contribute to another 20 GW of coal retirements by 2030
 - Compared to last quarter, projected coal retirements have increased primarily due to higher coal transportation rates and lower gas prices in certain regions. Nearly 8 GW of these retirements represent units switching from coal to gas
 - The majority of incremental retirements are units which were already in compliance with MATS either due to controls and/or use of MATS-compliant fuels so they would not incur any new significant investment in 2015/16



Note: Retired capacity is cumulative with 2015 as base year. % of region's coal figures are based on available coal capacity at the end of 2014, and retirements through 2016.

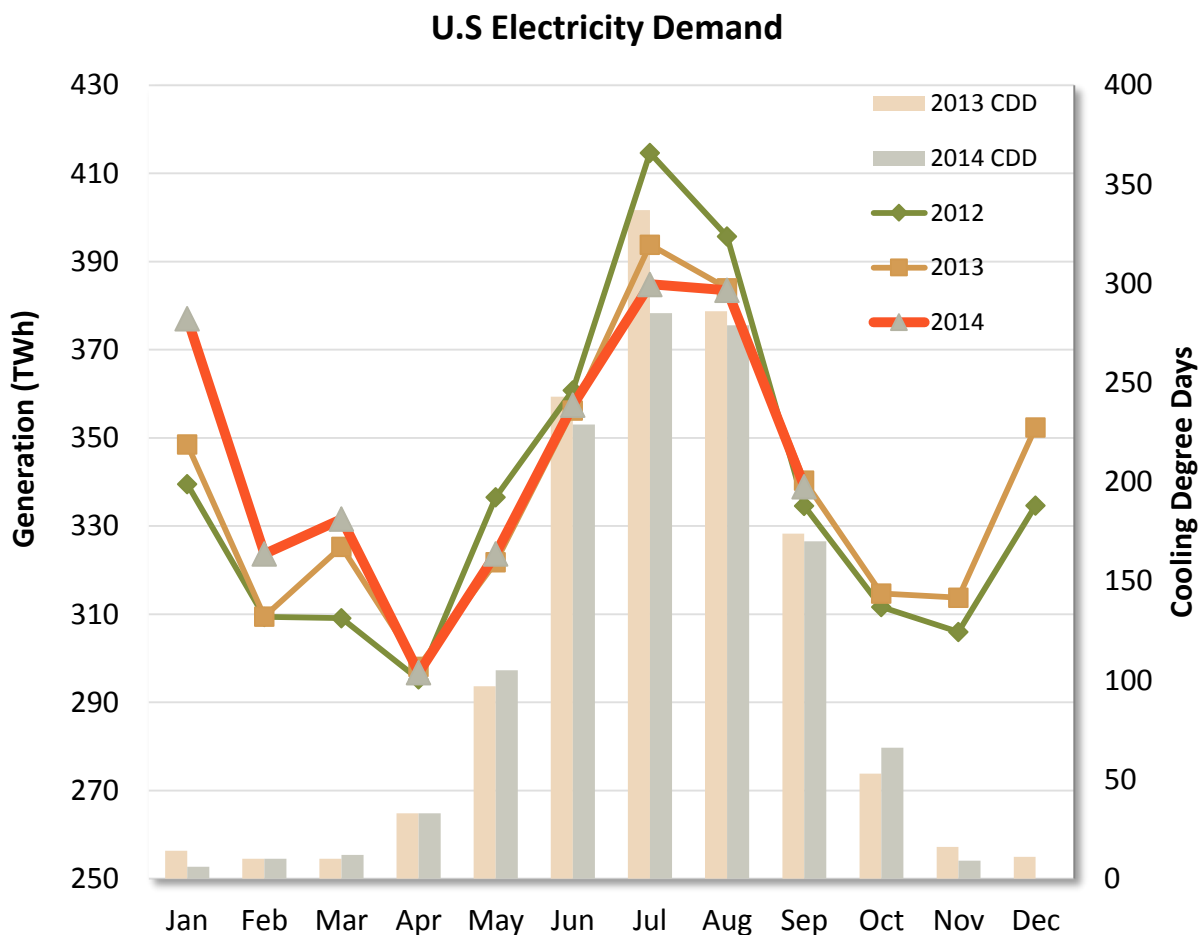


Recent Trends

Q3 2014: Relatively cooler summer tapered off gain in demand growth in first half of 2014



- Due to the “polar vortex,” energy demand was 1.3% higher through third quarter of 2014 compared to energy demand in the previous year
 - Q3 2014 energy demand decreased by 1% in comparison to Q3 2013 due to a relatively mild summer season depicted by the low cooling degree days (CDD)
- 2013 energy demand was 0.3% higher than the previous year, also due to cold weather-driven demand

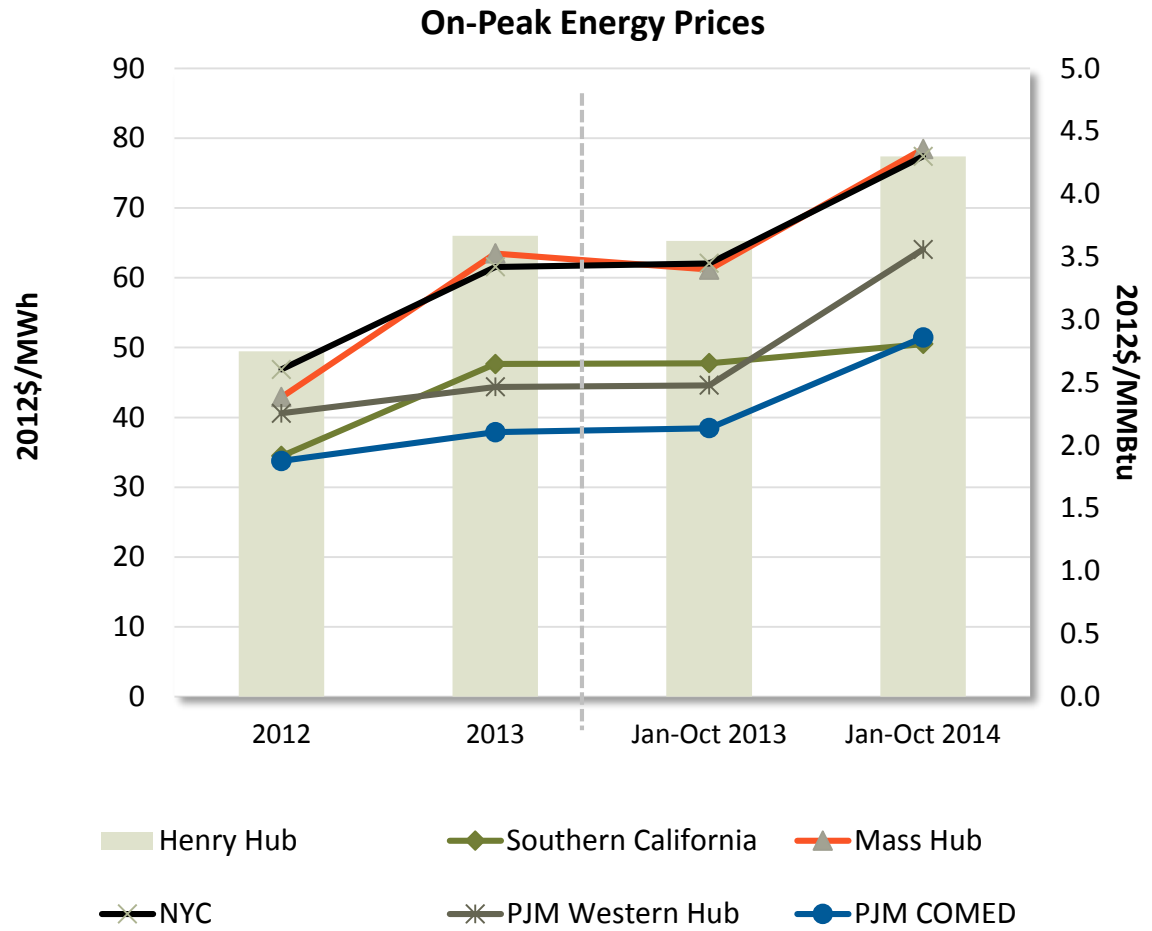


Source: EIA Electric Power Monthly, August 2014 and NOAA

On-Peak prices spike due to volatile weather and higher gas prices



- Higher energy demand and gas prices due to extreme cold weather in Q1 2014 resulted in higher year-to-date average on-peak prices in the first ten months of 2014
- In 2013, on-peak energy prices recovered from the previous year based on higher gas prices rather than strong demand growth
- Energy prices are still far below highs seen in 2008, due in part to much lower natural gas prices and a gradual recovery from the recession



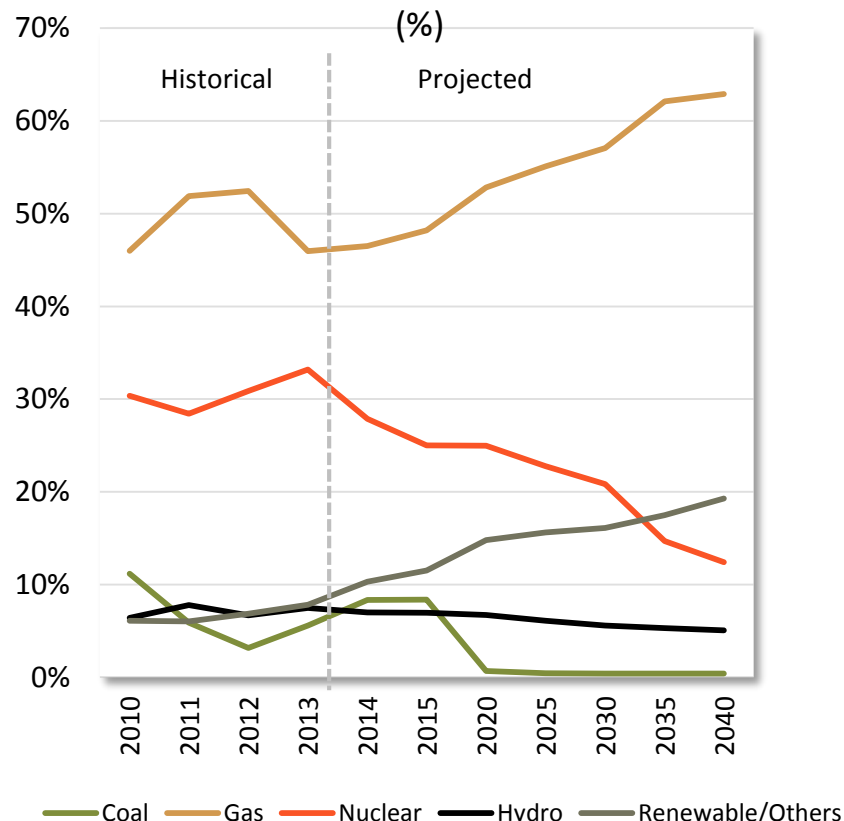
Source: ISO data (historical): 2012, 2013, 2014

New build opportunity in ISO-NE as capacity shortfall projected by 2017

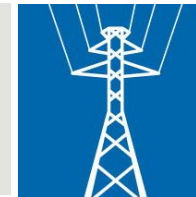


- ISO-NE's latest regional system plan forecasts energy demand, unadjusted for energy efficiency, to grow annually by 1% through 2023 while summer peak demand is expected to grow by 1.3% annually
 - New resources required to meet capacity shortfall due to 4,000 MW of resource retirement expected from June 2014 to June 2017
- For the 2018/2019 forward capacity auction, a downward-sloping demand curve and seven year lock-in period will be implemented which could yield smaller swings in capacity prices during the period when new capacity is required
 - Utilities have requested FERC to implement a mechanism to address the affect of rules, which lack floors for price-locked resources' offers during the lock-in period and zero price offers in subsequent auctions
- Overdependence on natural gas, pipeline congestion and lack of firm gas supply contracts by generators propels ISO-NE to gain FERC's approval to repeat and expand upcoming winter reliability measures
 - Incentivizing dual-fuel testing and compensating for additional demand response, unused oil inventory and LNG contract volumes

ISO New England – Generation by Fuel Type

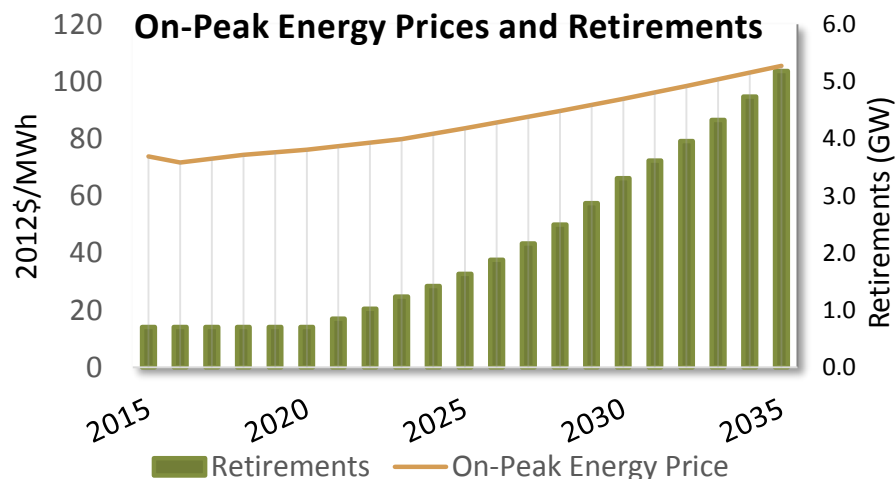
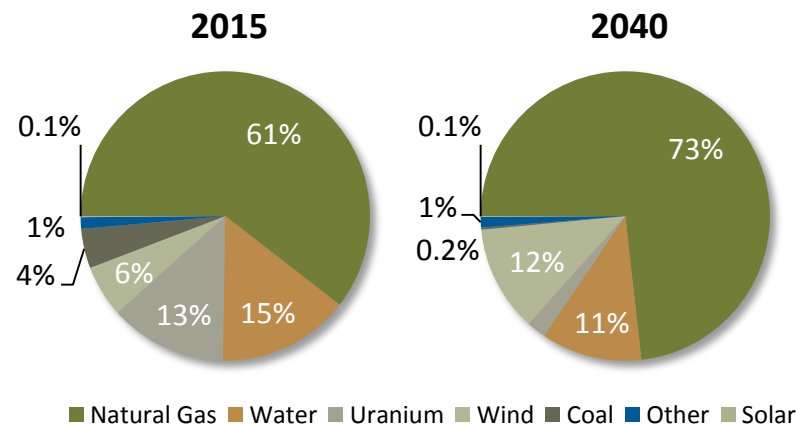


New York capacity needs creating development opportunities – regulators asked to step in



- Utilities have requested FERC to exempt non-subsidized new entrants from buyer-side mitigation rules
 - Existing rules require all new entrants in the New York City or Lower Hudson Valley capacity zones to sell capacity at a floor price based on the net cost of new entry, or CONE, of either a reference unit or the supplier's own unit
- In the 2014 Reliability Needs Assessment, NYISO identified potential transmission security violations due to mothballs and retirements beginning in 2015, particularly in Rochester, western and central New York and Lower Hudson Valley/New York City region
 - The assessment identifies resource adequacy concerns beginning in 2019 in southeastern New York, one year earlier than identified in the 2012 assessment
- R.E. Ginna nuclear power plant's bid to negotiate a reliability contract was protested by NY generators and large energy consumers as it has not stated its intention to retire the plant
 - PPA expired in June, however, it is licensed to operate until September 2029. NYISO in its May study confirmed reliability need through Oct 1, 2018
- NYISO expects peak demand to grow at a faster rate of 0.83% per year than annual demand at 0.16% over the next decade, highlighting the need for diversified energy sources

NYISO Capacity by Fuel Type (%)

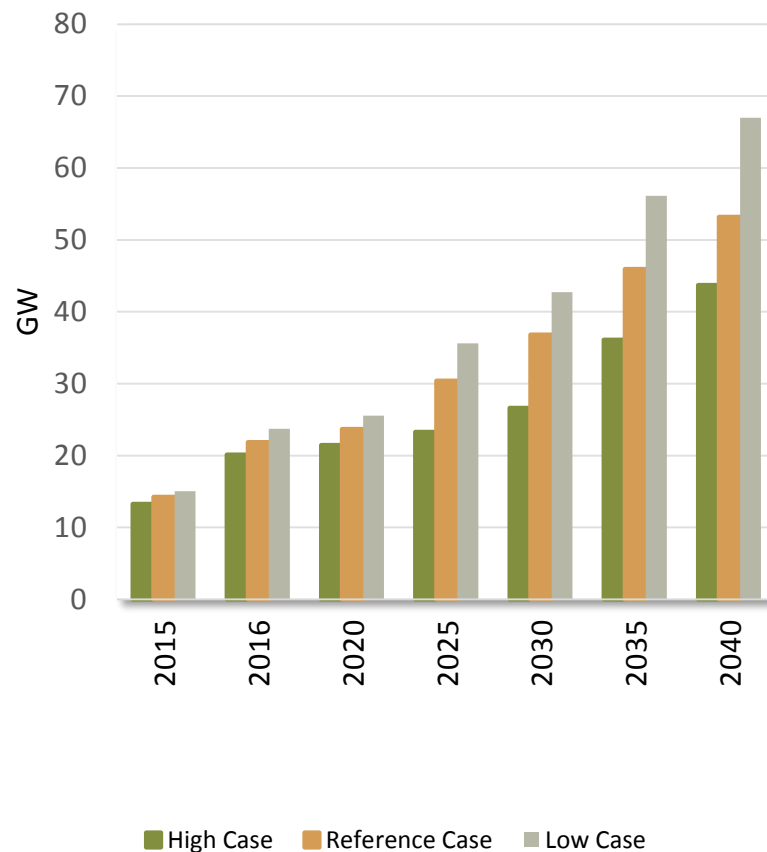


PJM filed proposal to add capacity performance product in next capacity auction



- November 28, FERC approved PJM’s revised pricing parameters for the capacity market auction. The modified pricing element includes the demand curve, cost of new entry (CONE) and the energy and ancillary service change. The new parameters:
 - Revise the shape of the VRR curve (market demand curve) more conservatively to ensure no more than one loss of load expectation event every 10 years
 - Update the CONE values that use an 8.0% cost of capital for a generic merchant plant in PJM and lower estimate of construction labor costs. However, FERC rejected PJM's proposal to establish a floor for net CONE in constrained deliverability sub regions
- Driven by increasing coal retirements and wary of gas dependency, PJM filed with FERC a proposal to add a capacity performance product in its May 2015 forward capacity auction to ensure fuel security and to maintain resource reliability in the wake of extreme weather events
 - The proposal will reward generators that perform or over-perform during peak demand hours and penalize those that do not
- A comparable rate of generator outages in the winter of 2015/2016, coupled with extremely cold temperatures similar to 2014 and expected coal retirements would likely prevent PJM from meeting its peak load requirements again
 - ICF projects 53 GW of retirements by 2040

PJM Retirements

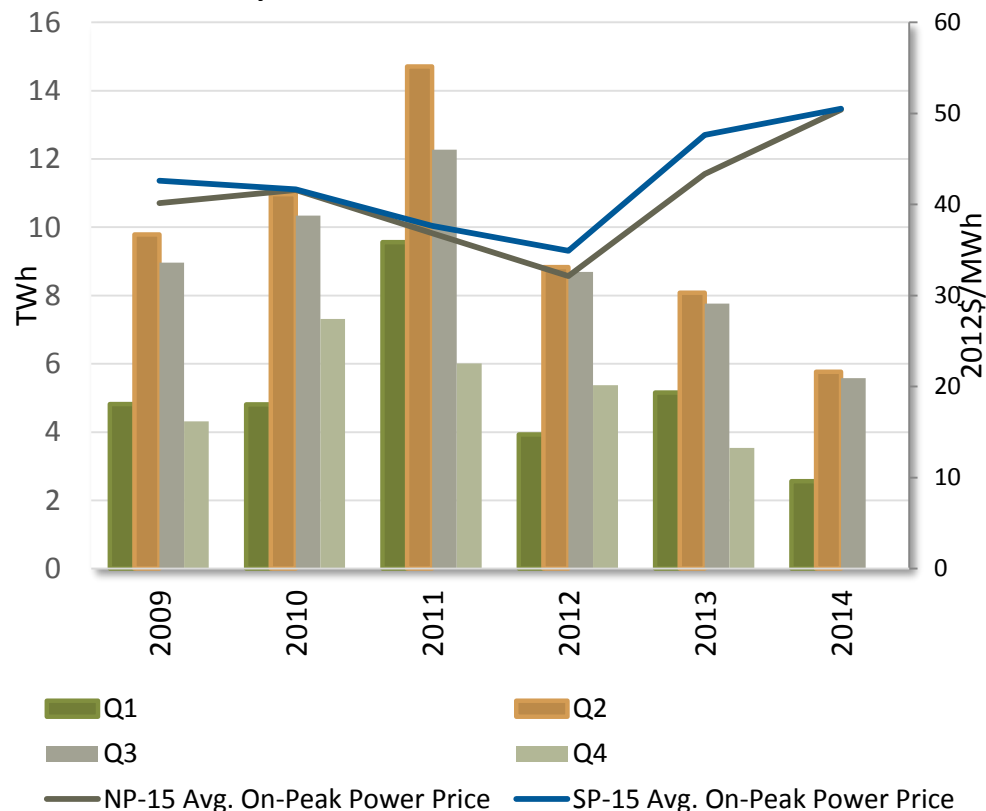


California: Energy imbalance market faced transitional issues on launch



- The regional energy imbalance market (EIM), currently comprising CAISO and PacifiCorp was launched on November 1
 - Extends real-time ISO market to include balancing authorities which will help integrating renewable resources to enhance system reliability
 - CAISO and PacifiCorp faced transitional issues as fewer resources participated in the EIM than originally expected, causing prices to spike
 - CAISO requested FERC for 90-day price cap on energy imbalance market and to provide a waiver that would allow it to relax constraints without triggering a \$1,000/MWh energy bid price cap
- Western U.S. drought continued through summer, impacting hydroelectric supply in California. California State Water Resources Board adopted a new regulation impacting hydroelectric plants that use water for cooling
- California regulators approved 939 MW AES Huntington Beach gas repowering project in Southern California, compensating the loss of generation due to San Onofre nuclear plant

Hydro* Generation in California

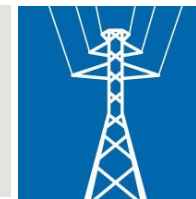


* Hydro exclude pumped storage



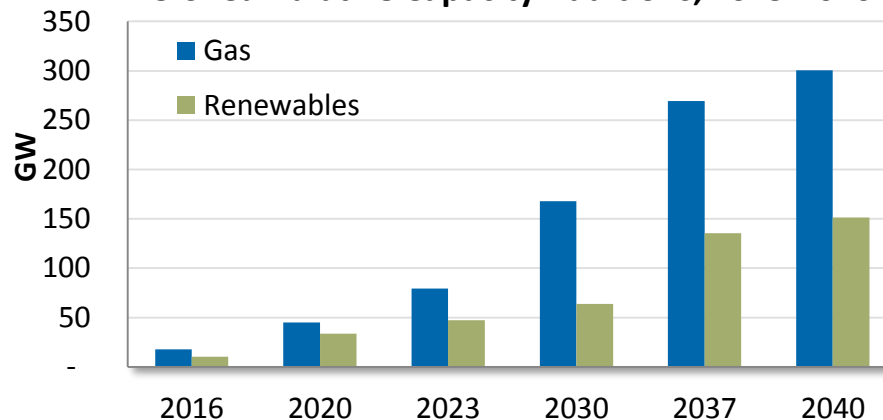
Market Projections

Opportunity for gas, wind and solar developers

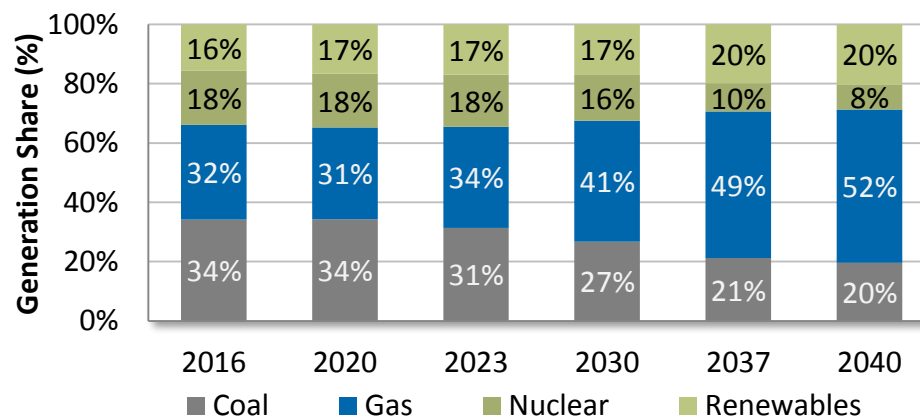


- U.S. power market will add over 230 GW of new capacity by 2030, beyond what is already under construction, to meet demand and state renewable portfolio standards
 - Recent CO₂ proposals for new and existing power plants, if implemented, will further strengthen current market trends favoring natural gas and renewable technologies
- Wind and solar technologies will continue to dominate the renewable build mix, but low capacity factors keep their share of total generation nearly constant through 2030, growing slightly in share to 20% by 2040
- In absolute terms, coal generation remains almost flat through 2020
 - More efficient, newer coal units increase dispatch to replace generation lost from retirements
 - By 2030, the CO₂ price will be high enough to force more coal out of the dispatch stack, and gas starts to dominate the generation mix
 - By 2040, retirement of nuclear units provides further momentum to gas-based generation

U.S. Cumulative Capacity Additions, 2015-2040



U.S. Generation Mix

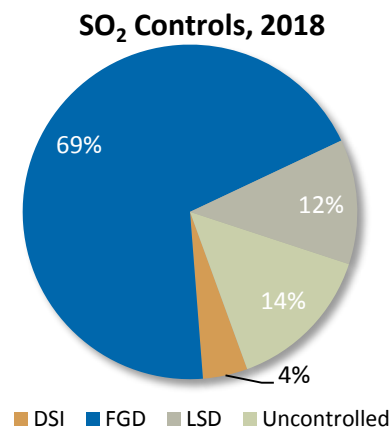
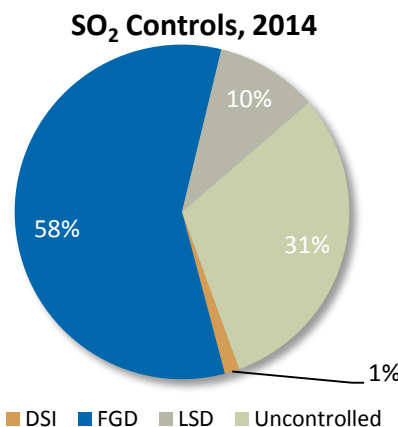
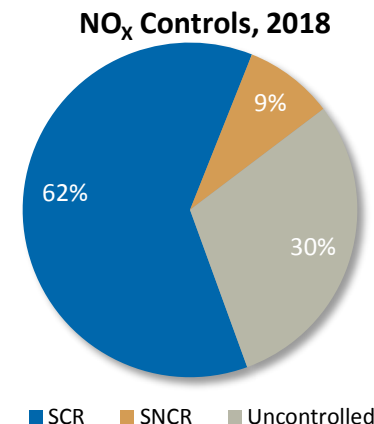
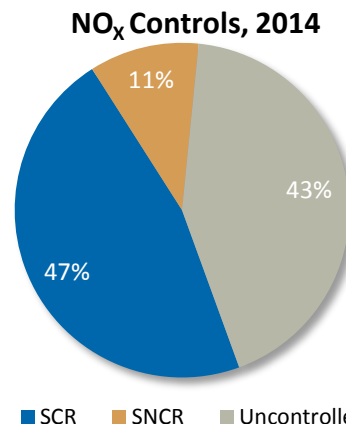


Note: Reported capacity is cumulative with 2015 as base year.

Return of CSAPR to Drive incremental NO_x Installations



- While EPA has re-instated CSAPR, it was too late to cover the change in this quarter’s outlook. ICF’s assumed NO_x regulation* starting in 2018 leads to incremental control installations
 - The assumed regulation reflects the potential for tighter emission caps corresponding to more stringent ozone and PM standards
 - By 2018, over 70% of the remaining post-MATS coal capacity will have some kind of post-combustion NO_x control
 - Units may also consider low cost compliance options, such as Low NO_x burners, Overfire Air etc.
- As a result of the MATS acid gas requirement, further PM regulation may have less impact on incremental SO₂ control decisions. There will be unit-specific needs in some states.
 - By 2018, over 85% of remaining coal capacity will have some kind of SO₂/HCl control
 - The remaining 14% of uncontrolled units will burn MATS-compliant subbituminous coals or install DSI to guarantee control across coal shipments with uncertain chlorine levels, but those controls may not operate over all hours



Note: Charts represent control status based on the existing and projected emission controls. For NO_x, if a unit has both SCR and SNCR, its share is counted under SCR.

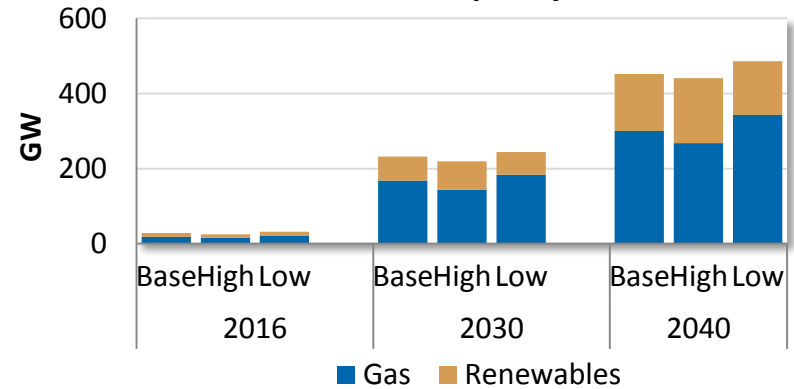
*see appendix for details on CAIR II assumptions.

High/Low Cases: Higher gas prices provide coal one third of dispatch share in long-term

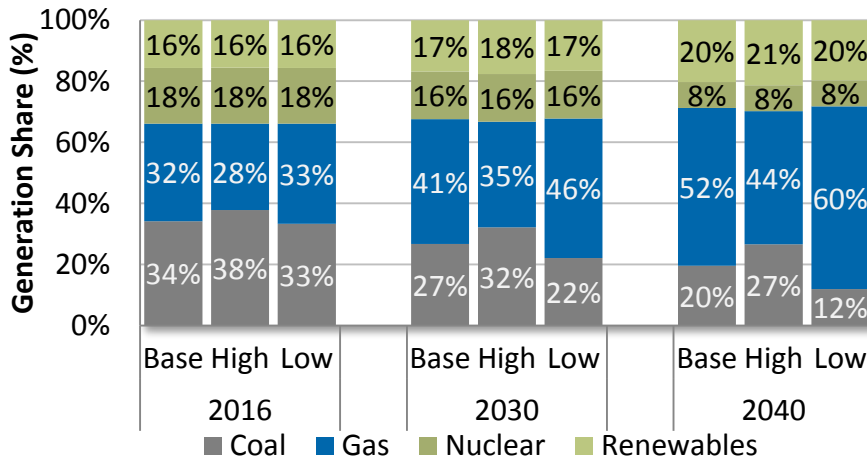


- The ICForecast includes High and Low gas price sensitivity cases
- Gas price differences translate directly into movements in retirement and build projections
- Higher gas prices translate into more coal capacity remaining online post-2016 and also contribute to the economics of new wind capacity relative to new gas-fired builds
- Higher gas prices decrease coal retirements by nearly 30% and keep coal's generation share to over 30% by 2030
- Lower gas prices increase coal retirements by nearly 20% and drive coal's generation share to just over 20% by 2030

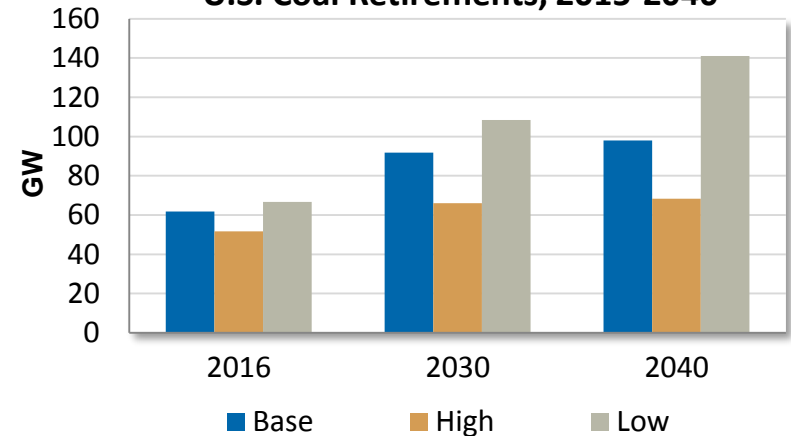
U.S. Cumulative Capacity Additions



U.S. Generation Mix



U.S. Coal Retirements, 2015-2040



Note: Reported capacity is cumulative with 2015 as base year.

Behind the Strategic Power Outlook



- ICF's long-term market forecasts are built on foundations of solid, rational, defensible assumptions that are reviewed and validated on a continuous basis by our expert staff. For the ICForecast products, those assumptions include economic inputs for fuels, regulatory policy, market demand, and others. Each of these categories have hundreds of discreet inputs like natural gas pricing, coal pricing, the price of carbon, macroeconomic indicators, new generation technology, to name a few.
- The core value of ICForecast products is derived from our staff of the most experienced energy consultants and analysts in the world. Having served hundreds of clients globally, our staff provides rigorous analytics and thoughtful insights into the complex and dynamic power and fuels markets. The ICForecast products and services are built on the team's decades of experience in power, natural gas, coal, emissions, and regulatory markets. This experience in market dynamics and model development ensures a robust integrated energy market view is captured and sets ICF apart from the competition.
- The model that brings these assumptions and methods together, the Integrated Planning Model (IPM[®]) is a culmination of ICF Consulting's 35 years of experience helping private and public sector clients evaluate the complex dynamics of power, fuel, and environmental markets. ICF started using the name IPM[®] around 1980 in a long-term decision analysis tool. Later tools focused on pricing in near- and mid-term markets were developed 1993. In 1999 all generation sector modeling tools were integrated into the single integrated IPM[®] tool.
- ICF uses IPM[®] to synthesize our expertise in wholesale electric markets (including transmission markets), air pollution regulations, and fuel markets into one integrated framework. IPM[®] is a linear optimization model utilizing a Windows based database platform and interface to capture a detailed representation of every electric boiler and generator in the European, Russian, North American or Singapore regions. The fundamental logic behind the model determines the least cost means of meeting electric generation energy and capacity requirements whilst complying with specified constraints including air pollution regulations, transmission constraints, and plant specific operational constraints.
- The conclusions are that the ICForecast uses rigorous assumptions developed by the industry's most experienced experts and modeled in a time-tested model that provides an integrated energy market outlook.

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ICForecast Strategic Power Outlook.**

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