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Flexibility and Resilience in PJM

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Data Sources Used in This Publication
PJM
Energy Information Administration
PointLogic Energy
Intercontinental Exchange

PJM's View of the Future

At the end of December, PJM published two reports used to inform their planning. The first is the *PJM Reserve Requirement Study*, which determines the Installed Reserve Margin, or IRM, and the Forecast Pool Requirement. The second is the *PJM Load Forecast Report,* which forecasts 10-year load growth and serves as the regional transmission organization's, or RTO's, long-term demand assumption. This note highlights the assumptions PJM uses, along with our takeaways for the region's market.

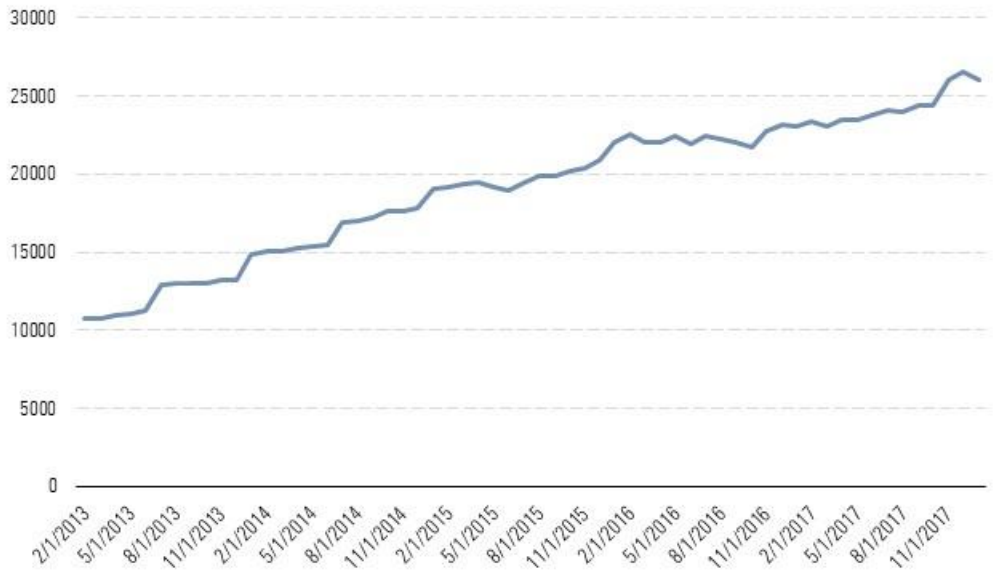
Long-Term Load Growth

PJM's service territory covers around 65 million people and represents a diverse set of regions, including large metropolitan areas and small single-industry-dependent regions. Among the industries driving long-term demand growth are manufacturing, healthcare, and the natural resource and mining industry. According to Moody's Analytics, there's a mixed bag of macroeconomic indicators affecting the territory. Its outlook on manufacturing output is positive, on stronger global demand and an expanding U.S. economy. However, it believes automobile and machine manufacturing has peaked. Additionally, tariffs on steel imports appear to be providing support to the steel manufacturing sector.

Although natural resources and mining represent only a small percentage of the service territory's overall economy, these two sectors have seen both growth and decline. Northeast natural gas production (Exhibit 1) has grown to around 26 billion cubic feet per day from around 10.5 Bcf/d in 2013, with the bulk of this growth seen in Pennsylvania and Ohio. PJM has generally benefited from abundant access, as pipeline constraints have kept large amounts of gas in the region, and this situation will probably continue.

The natural gas boom in this region has come at the expense of the mining sector, which saw year-over-year declines in Central and Northern Appalachian production. The mining sector, however, may see a recovery on the horizon. Prices have hovered around $65.00/short ton, and coal exports in November 2017 reached 9.5 million short tons, hitting the upper band of the five-year range. In aggregate, Moody's expects long-term real GDP growth to underperform the country, 1.8% versus 2.0% from 2017 to 2032. The slower GDP growth is the result of changes in population projections. Moody's revised its forecast for population expansion, which will affect long-term power demand, down to 4.8% from 5.8% last year.

Exhibit 1 Northeast Modelled Dry Gas Production (MMcf/d)



Source: Point Logic Energy

PJM increased its summer peak load growth rate by 0.2% per year to 0.4% in its 2018-28 forecast. The same forecast also moved the winter peak load growth rate to 0.4% from 0.3% last year (Exhibit 2). The regions expected to see the greatest growth are Dominion, Allegheny Power, and Duke Energy Ohio/Kentucky. The regions expected to see load reductions over the same period are Atlantic City Electric Company, Baltimore Gas and Electric, and UGI. PJM's latest forecast revised summer peak load down for 2018-22 and moved load up for 2024-33 compared with last year's forecast. Winter coincident peak demand was also moved down for 2018-21 and moved up for the years between 2023 and 2033. These revisions stemmed from changes in GDP growth for the metro areas in the service territory.

Exhibit 2 PJM-RTO Summer Coincident Peak Demand (MW)

Month	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
1	131,463	132,357	132,039	132,401	133,117	133,802	134,435	134,694	135,341	135,926	136,702	137,199	138,120	138,469	139,216	139,975
2	125,261	126,529	125,647	126,525	127,533	127,756	128,905	128,534	129,312	130,018	131,265	131,319	132,547	132,288	133,200	134,430
3	111,587	112,239	114,106	115,044	112,769	112,870	113,262	114,900	116,650	117,975	115,555	115,966	116,495	117,922	120,162	118,514
4	107,062	107,902	109,835	109,380	105,571	103,892	108,958	110,622	112,284	112,469	106,743	111,086	112,063	113,732	114,720	111,141
5	119,510	119,735	118,293	118,537	120,067	120,599	121,072	121,366	121,677	122,263	123,957	124,861	125,411	125,397	125,381	127,744
6	143,149	143,477	143,122	143,525	144,103	144,798	145,130	145,921	146,781	147,645	148,732	149,484	150,125	151,123	152,104	152,997
7	152,108	152,479	151,962	152,363	152,887	153,632	154,245	154,941	155,724	156,605	157,635	158,624	159,412	160,294	161,259	162,095
8	147,690	148,058	146,147	147,847	148,607	149,294	149,743	150,340	150,226	151,952	153,161	153,982	154,725	155,606	156,456	157,483
9	127,594	128,826	129,310	129,726	130,170	130,459	130,988	132,011	133,168	133,798	134,069	133,996	135,641	136,769	138,018	138,799
10	108,345	108,611	107,362	107,128	106,367	108,073	110,576	110,944	110,869	110,689	111,217	114,306	114,820	115,265	114,270	113,042
11	110,462	109,753	109,703	110,150	111,146	111,726	111,186	111,596	112,413	113,178	114,391	115,130	114,589	115,071	116,204	117,171
12	125,741	125,274	125,722	126,147	126,988	127,476	127,361	128,679	129,187	129,643	129,802	131,695	131,167	132,512	133,012	132,425

Source: PJM

Reserve Requirements

The Reserve Requirement Study released in December recommended lower IRMs in the later years when compared with the 2016 report (Exhibit 3). The decrease in IRMs is tied to adjustments in the Effective Equivalent Forced Outage Rate-Demand, or EEFORd, variable. The EEFORd went from 7.35% in last year's report to 6.62% this year. The changes to the EEFORd were from a higher average EEFORd (16.36%) on 7,150 MW of retirements and a lower average EEFORd (4.97%) on 16,980 MW of additions. This implies newer gas units, which have a lower outage rate, will provide the necessary reliability, versus the slower-start older units with a higher outage rate, which justifies the lower reserve margins over time. The 11-year reserve requirement view ultimately shows IRMs declining through 2027. Even with reductions in the overall reserve requirements, PJM's target is in line with the IRMs of its surrounding operators (NYISO, MISO, TVA, and VACAR), which fall between 15% and 18%.

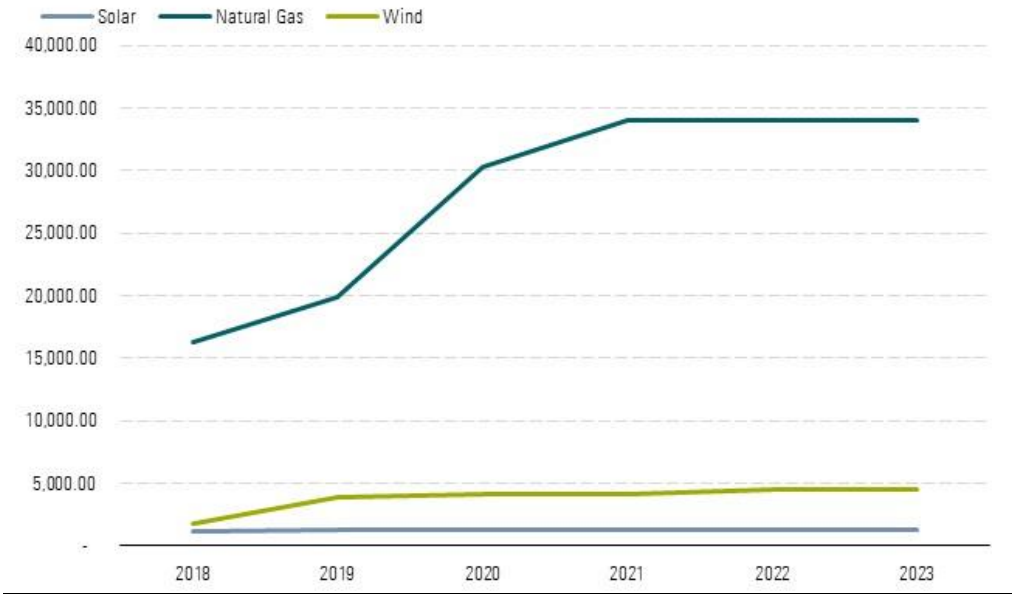
Exhibit 3 11-Year Reserve Requirement Study

	Calculated IRM					Forecast Reserve				
	A	B	C	D	E	F	G	H	I	J
Delivery Year	IRM PJM RTO % (2 area)	IRM Outside World %	Average PJM EEFORd %	Average Weekly Maintenance %	Forecast Pool Require-ment (FPR)	Capacity MW	Restricted Load MW	Forecast Reserve PJMRTO %	Forecast Unrestricted Reserve PJM RTO %	PJM Reliability Index without World Assistance (years/day)
2017	16.7%	17.4%	7.3%	8.3%	1.0974	184,799	143,879	28.4%	20.8%	5.9
2018	16.1%	17.4%	6.8%	8.1%	1.0962	189,810	144,764	31.1%	23.3%	5.9
2019	15.9%	17.3%	6.7%	8.1%	1.0896	196,227	145,074	35.3%	27.2%	6.0
2020	15.9%	17.3%	6.7%	8.4%	1.0898	191,413	147,507	29.8%	24.5%	5.9
2021	15.8%	17.2%	6.6%	8.4%	1.0898	192,118	147,215	30.5%	25.3%	5.9
2022	15.8%	17.2%	6.6%	8.4%	1.0898	192,118	147,256	30.5%	25.2%	5.9
2023	15.8%	17.2%	6.6%	8.4%	1.0898	192,118	147,548	30.2%	25.0%	5.9
2024	15.8%	17.2%	6.6%	8.4%	1.0898	192,118	147,955	29.8%	24.6%	5.9
2025	15.8%	17.1%	6.6%	8.4%	1.0898	192,118	148,368	29.5%	24.3%	5.9
2026	15.7%	17.1%	6.6%	8.4%	1.0889	192,118	148,924	29.0%	23.8%	5.9
2027	15.7%	17.1%	6.6%	8.4%	1.0889	192,118	149,536	28.5%	23.3%	5.9

Source: PJM

Considering stable reserve margins, PJM and the surrounding area will see fundamental changes to their generation mix (Exhibit 4). For the states in PJM and surrounding areas (Eastern MISO, TVA, NYISO, and VACAR), natural gas is set to add substantial generation capacity. According to the EIA, this region will add 16,000 MW of natural gas generation, of which we expect 14,000 MW to come on line this year. The region will also see gains in solar, primarily in North Carolina, and may add 4,000 MW of wind generation by 2019. Along with new generation, PJM continues to shed coal assets, slating 3,000 MW of coal retirements this year. Further concerns regarding the Davis-Besse Nuclear Facility's long-term viability in the absence of state action to subsidize operations threatens an additional 906 MW of resilient generation. The continued reshuffle of generation assets may create long-term strategic challenges for PJM as it tries to guarantee reliability, with fewer assets best designed to handle sustained demand shocks.

Exhibit 4 Planned Power Plant Construction PJM and Surrounding Area (MW)



Source: EIA

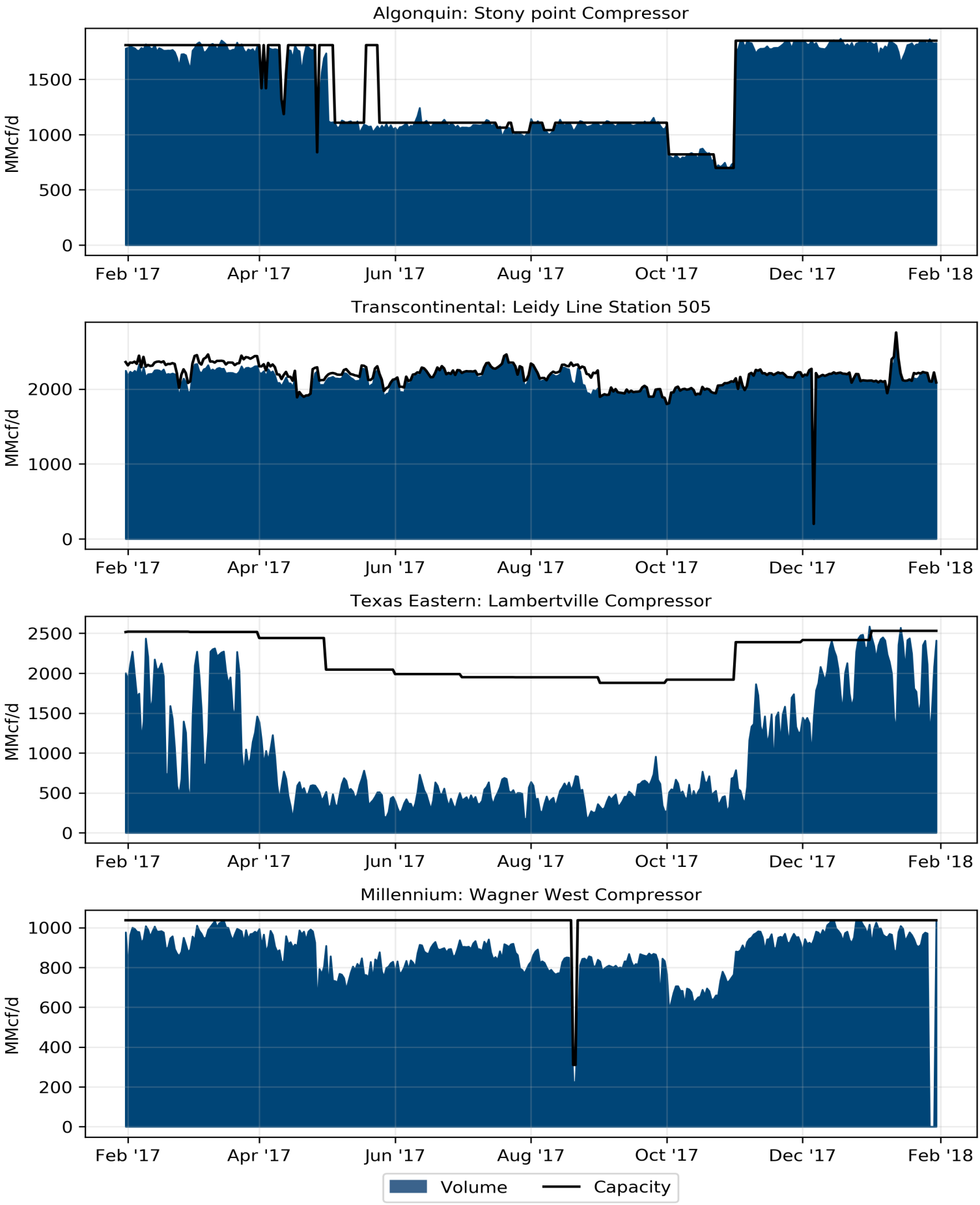
Viewpoint

These PJM studies hold few surprises for us. Long-term PJM demand is unlikely to grow unexpectedly. Macroeconomic headwinds and population trends for the service area suggest load growth lagging the U.S. as a whole. For resource adequacy, PJM's study forecasts reserve margins declining over the next 11 years with little change in the reliability index. However, the target reserve margin falls within the range of similar IRMs. The greatest impact for the region comes from continued growth in natural gas generation.

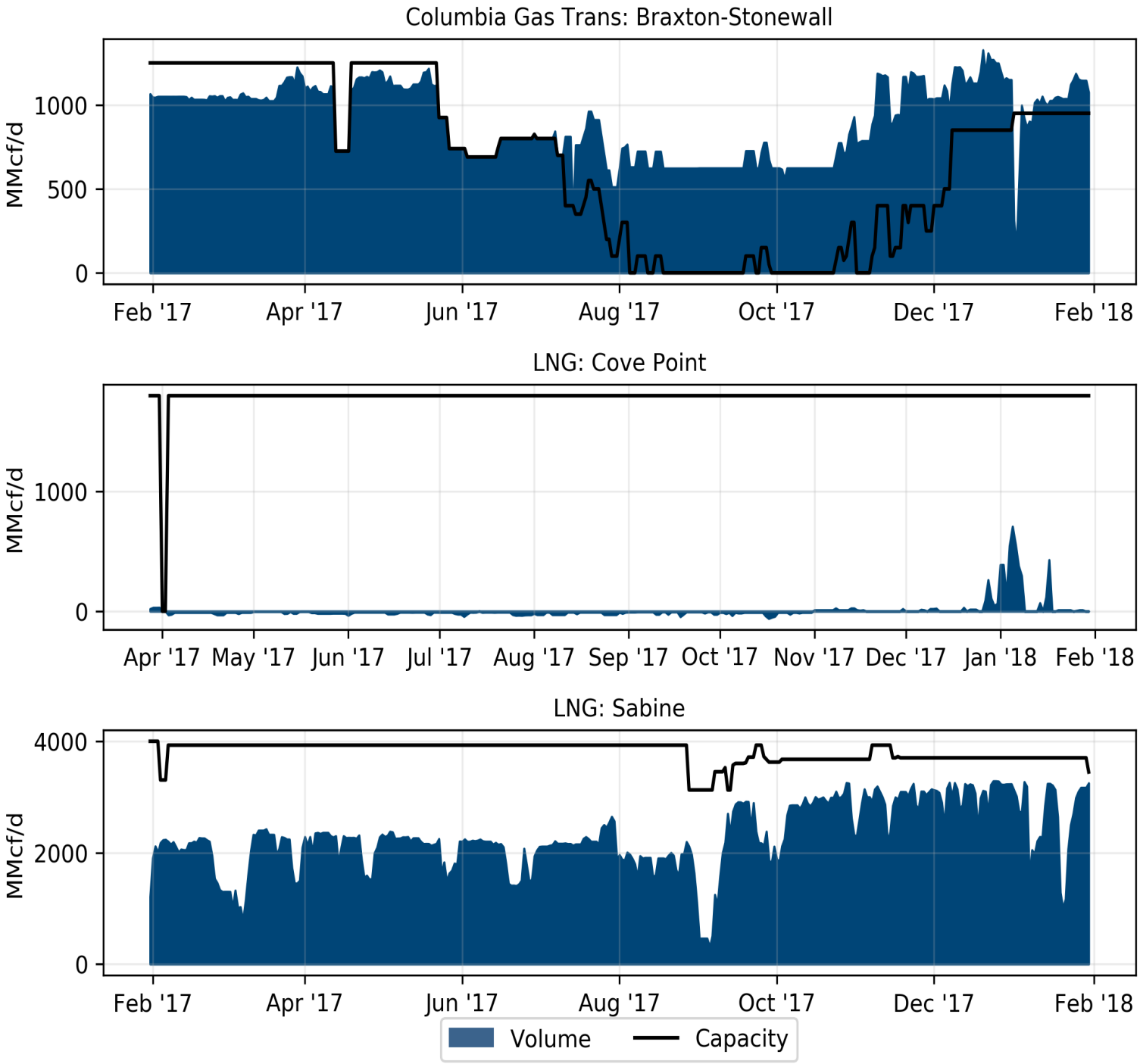
Takeaways

- Replacing coal generation with new natural gas plants will increase competition between gas generators, as they occupy a larger share of the stack.
- The build-out of solar and wind and the future deployment of storage technologies continue to put pressure on prices as renewables claim greater market share.
- Natural gas plants will need to adjust their natural gas bid strategies as greater competition between gas generators grows, and their power offer strategies as renewable output affects the amount of generation needed to meet load.
- Natural gas generators will need to adjust their output to cover retired baseload nukes and coal.
- As pipeline constraints resolve, and Marcellus/Utica natural gas finds demand outside of PJM over the next several years, the ISO is likely to experience greater price volatility.
- Increased market share for units with greater flexibility (natural gas) over resilience (nuclear and coal) is the driver behind FERC and PJM's review of price-setting rules. As this winter has shown, coal is needed to ensure reliability, and without further action to make slow-start units competitive, PJM may find itself in an untenable position.

Natural Gas Important Points



Source: Pointlogic Energy



Source: Pointlogic Energy

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