Electricity Price Outlook for December 2017

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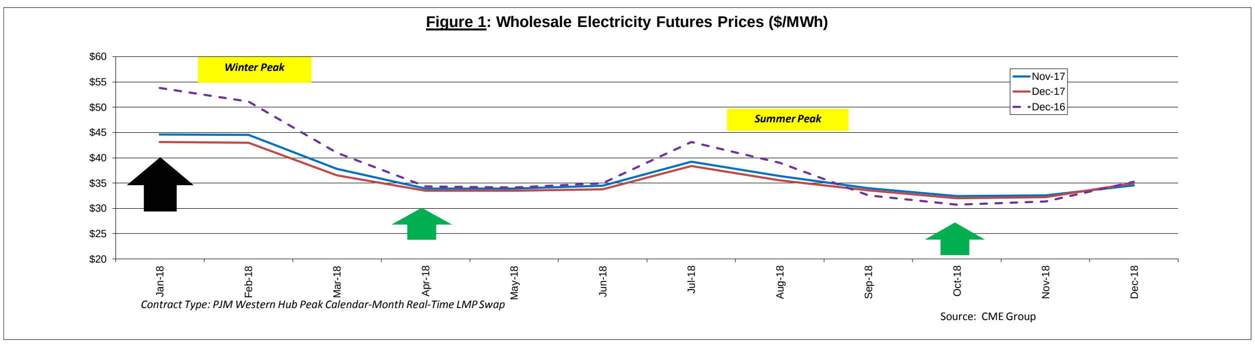
The Office of Technical and Regulatory Analysis presents the outlook for wholesale electricity prices each month. This assessment considers trends in electricity futures markets as well as forecasted weather, economic growth, and input fuel prices.

Wholesale Electricity Futures Market

Contracts to deliver electricity in future months are traded for the multi-state region that is served by regional transmission operator PJM Interconnection and includes the District of Columbia. Figure 1 below shows the futures contract "price strips" through December 2018 as settled on November 26, 2017 (blue line), and on December 10, 2017 (red line).[1]

Because electricity cannot be easily stored, the effect of seasonal temperature changes on the price of future delivery contracts stands out sharply, with yearly peaks in the hot summer months and cold winter ones. Wholesale prices rise to incentivize high-cost generators to turn on their power plants to meet the high demand for electricity to run air conditioning on hot summer days and heating systems on cold winter days.

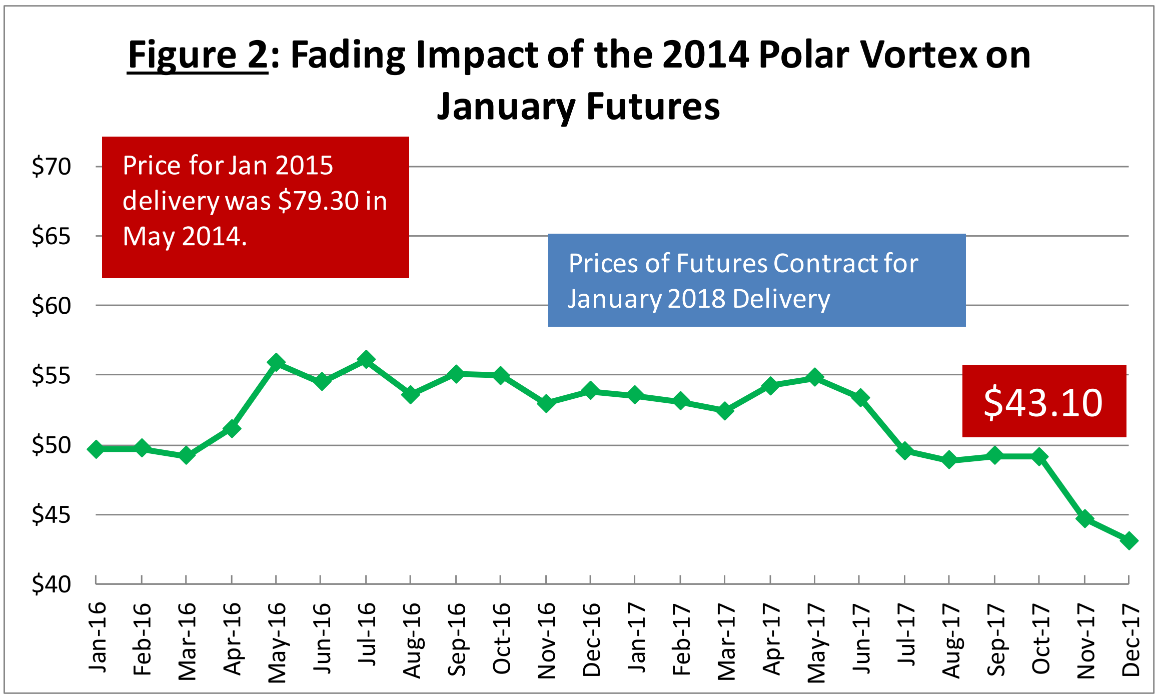


In Figure 1 above, the dashed purple line shows the trading values for the "price strip" from one year ago (December 21, 2016). Price expectations for most months are <u>below</u> last year's levels. Near-term investor expectations of future electricity prices have dropped since last month (blue line). Price expectations for the coming winter months are well <u>below</u> last year's levels (dashed purple line) see the black arrow. As can be seen in Figure 1, the trend of January (winter) prices exceeding July (summer) prices continues.

[1] See PJM Western Hub Peak Calendar-Month Real-Time LMP Swap Futures; CME Group.

Price expectations during the “shoulder months” remain close to where they were a year ago. The green arrows (see Figure 1 above) point to the “shoulder months” of April 2018 and October 2018. During these months, temperatures are moderate and demand can be met from less expensive generation like nuclear and wind.

The green line in Figure 2 (below) illustrates how investors have responded to the unusually cold winter weather experienced during the “Polar Vortex” of January 2014 -- and the February 2015 cold snap -- as they form expectations about the price of electricity in coming winter months. In May 2014, the price of a MWh for delivery in January 2015 closed at $79.30. Investors’ fears about the risk of January generation outages seem to be moderating and have returned to pre-Polar Vortex levels.[2] The most recent price for January 2018 delivery is $43.10 – a slight decrease from the previous month.



Behind these price movements are the extraordinary demands for electricity during January 2014 when eight of the 10 highest winter demands for electricity ever recorded in the PJM region occurred. PJM set a new, all-time winter peak demand of 141,312 megawatts during the evening of January 7, 2014.[3] PJM reports that these January 2014 cold-weather events

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[2] The Federal Energy Regulatory Commission held a hearing about the January 2014 cold snap. The FERC Staff presentation can be found at this link: http://ferc.gov/legal/staff-reports/2014/04-01-14.pdf.

[3] PJM’s previous, all-time winter peak demand was 136,675 MW, on February 5, 2007. PJM GRID MEETS MONTH-LONG CHALLENGES OF COLD JANUARY; January 31, 2014; http://pjm.com/~/media/about-pjm/newsroom/2014-releases/20140131-pjm-grid-meets-month-long-challenges.ashx.

resulted in an unusually high level of "forced outages" of generators serving the PJM system; this created a "shortage effect" that drove wholesale prices temporarily higher.[4]

On February 20, 2015, PJM set another new peak for winter demand -- 143,826 MW -- when PJM's "forced outage" rate peaked at 13.3 percent. It is notable that this reduced rate of forced outage is well below the "forced outage" rate of 22.2 percent experienced by PJM generators on January 7, 2014.[5] This shows that PJM has learned some lessons since the "Polar Vortex." Investor anxiety about PJM's capacity to meet extreme demand in the future seems to have largely abated.

Retail Residential Electricity Prices

The U.S. Energy Information Administration's (EIA) *Short-Term Energy Outlook (STEO)* reports that retail residential electricity prices are expected to increase by 2.7 percent in 2017 nationwide and a further 2.6 percent increase is projected in 2018.[6] Factors other than generation costs play a role, including the need for continued investment in transmission and distribution infrastructure.

On March 1, 2017, the Public Service Commission of the District of Columbia approved the results of the annual competitive auction for new electric generation rates for default service, called Standard Offer Service or SOS, which went into effect on June 1, 2017. As a result of a competitive auction overseen by the Commission, the price to compare (generation plus transmission) for a residential standard SOS customer decreased, on average, by about $1.10 per month for the average user of 659 kWh/month. The residential standard SOS customer's summer price to compare rate decreased from 8.0 cents per kWh to 7.6 cents per kWh while their winter rate will stay at 8.2 cents per kWh. On average, the price to compare for small commercial SOS customers decreased about $0.07 per month for the average user of 2,061 kWh/month. Overall, residential standard SOS customers will face an average bill decrease of 1.3 percent, while small commercial customers will face an average bill decrease of 0.03 percent.[7]

The following sections provide a brief discussion of some of the factors affecting this month's outlook, including the three-month weather forecast, the overall economic outlook, and the prices of fuels used in power generation.

Weather Outlook

Sea-surface temperatures in the equatorial Pacific Ocean influence weather patterns across North America; these so-called *La Niña/El Niño* conditions are the primary factor in the three-month temperature outlook which, in turn, impacts investor expectations about future electricity prices.

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[4] See PJM; "Generation Forced Outages for January 6-8, 2014"; http://www.pjm.com/~/media/documents/reports/20140109-january-2014-cold-weather-peaks-and-generator-outages.ashx.

[5] *PJM weathered 2015 winter demand better than 2014: staff;"* Platts; 20 April 2015; http://www.platts.com/latest-news/electric-power/houston/pjm-weathered-2015-winter-demand-better-than-21320423.

[6] *December 2017 Short-Term Energy Outlook (STEO)*; Table 7c; http://205.254.135.24/forecasts/steo/.

[7] Formal Case No. 1017; Order No. 18713; March, 2017.

The National Oceanic and Atmospheric Administration's December 14th *El Niño* watch indicates that *La Niña* is likely (exceeding ~80% probability) through the Northern Hemisphere winter, with a transition to ENSO-neutral most likely during the mid-to-late spring..[8] NOAA notes that, with ENSO-neutral conditions continuing for the present and increasing chances of a transition to *La Niña* conditions in the winter, above-normal temperatures are expected in the mid-Atlantic region through the January-February-March period.[9]

Heating-degree days measure the demand for heating during the winter. EIA reports that heating degree days in our region are projected to be about 12.7 percent higher in 2018 than in 2017. Projected heating degree days for 2018 are slightly below the ten-year average.[10]

Cooling-degree days measure the demand for air conditioning during the summer. EIA projects cooling-degree days in the Census region that includes the District of Columbia will be one percent fewer in 2018 compared to 2017. The projection for summer 2018 is 2.7 percent below the 10-year average.[11] The long-term warming trend continues.[12]

Economic Growth and Electricity Consumption

The outlook for economic activity in 2017 remains one of moderate growth. Real (inflation-adjusted) gross domestic product (GDP) is expected to increase and to continue bringing down the unemployment rate gradually. The EIA reports a real GDP growth rate of 1.5 percent for 2016. Real GDP is projected to grow by 2.2 percent in 2017 and 2.3 percent in 2018.[13] Slow economic growth depresses the growth of electricity sales and moderates prices of generation fuels.

EIA forecasts that residential electricity sales (measured in kWh) will decrease by two percent in 2017, followed by a three percent increase in 2018. Nationwide electricity sales for all sectors will be flat in 2017 and will increase by two percent in 2018.[14]

Fuel Prices

In recent years, the cost of fuels for electricity generation has been restrained, with the exception of petroleum-based fuels where the market remains volatile in both directions. This moderate trend is driven by historically low natural gas prices and moderate economic growth. The cost of natural gas for generation is projected to remain below the $4 level in 2017 and 2018.[15]

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8 http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/ensodisc.html. "ENSO" means *El Niño* Southern Oscillation; "ENSO-neutral" means that neither *El Niño* nor *La Niña* conditions are present.

9 http://www.cpc.ncep.noaa.gov/products/predictions/90day/fxus05.html.

10 *STEO*, Table 9c.

11 *STEO*; Table 9c.

12 NOAA National Climatic Data Center; Contiguous U.S. Temperature 1896 – 2016; https://www.ncdc.noaa.gov/cag/time-series/us/110/0/tavg/1/2/1895-2017?trend=true&trend_base=100&firsttrendyear=1895&lasttrendyear=2017.

13 *STEO*; Table 1.

14 *STEO*; Table 7b.

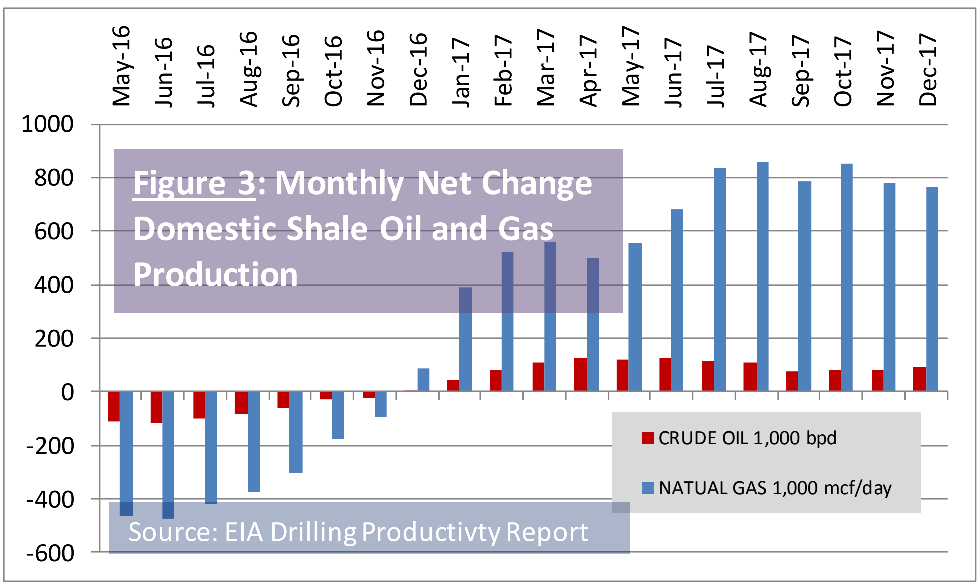
15 *STEO*, Table 7a.

Petroleum

The Organization of Petroleum Exporting Countries ("OPEC"), led by Saudi Arabia, are poised to extend output cuts agreed least year with allied, non-OPEC producers, and Russia has agreed to support the extension through the end of 2018.[16] North Sea Brent crude averaged $63 per barrel in November, a $5 increase from the October average. For the moment, OPEC and allied exporters appear to have succeeded in stabilizing Brent above their informal target of $50 per barrel. Brent crude is forecast to average $54 per barrel in 2017 and $57 per barrel in 2018.[17]

U.S. shale oil producers continue to raise their production, acting as a countervailing force to OPEC's output restraint. EIA estimates that U.S. crude oil production averaged 9.7 million barrels per day (b/d) in November, an increase of 360,000 b/d from October. EIA projects that domestic crude oil production will average 9.2 million b/d in 2017 and 10 million b/d in 2018 – up from 8.9 million b/d in 2016. If these forecasts hold up, 2018 would be the highest annual average in U.S. history, surpassing the 1970 record of 9.6 million b/d.[18]

Domestic crude oil output continues to show signs of recovery. The Wall Street Journal reports that domestic shale-drilling companies have significantly increased their budgets for 2017.[19] The latest *Monthly Drilling Report* from the EIA shows oil and natural gas output increasing in the U.S. shale-producing basins surveyed (see Figure 3).[20]



Net liquid fuel imports to the United States peaked at over 60 percent of domestic supply in 2005 and then fell to 24 percent in 2015 – the lowest level since 1970; this represents a major

16 "OPEC, Russia agree oil cut extension to end of 2018," Reuters; November 30, 2017.

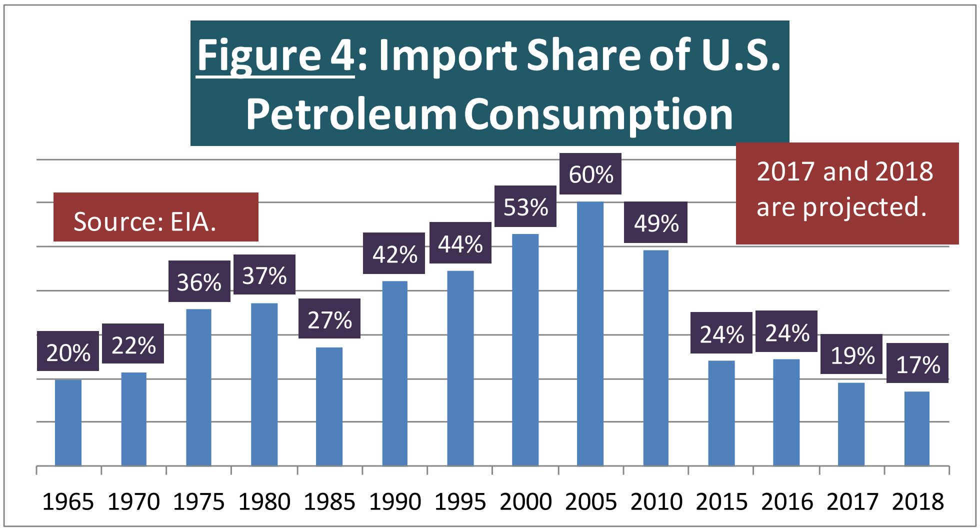
17 *STEO*, page 1. The "North Sea Brent Crude" is the key contract for setting the price of crude oil in international markets.

18 *STEO*, page 1 and Table 4a.

19 "Big Oil Firms Save While Upstarts Spend;" *Wall Street Journal*; January 30, 2017.

20 See EIA's monthly *Drilling Productivity Report*; http://www.eia.gov/petroleum/drilling/pdf/dpr-full.pdf.

shift in the structure of world oil markets.[21] EIA projects the import share to fall even further -- to 17 percent in 2018. [22] See Figure 4 below.



U.S. regular gasoline retail prices averaged $2.56 per gallon in November, an increase of six cents from October. EIA forecasts a price of $2.59 per gallon in December, which is 34 cents higher than last year.[23] Regular gasoline averaged $2.15 per gallon in 2016. EIA forecasts that gasoline prices will average $2.43 in 2017 and $2.51 in 2018.[24]

Despite extension of the OPEC-Russia agreement, EIA expects output from non-OPEC sources to increase in 2018. Oil price increases will be moderated by continuing growth in domestic production.[25]

Petroleum fuels made up 0.2 percent of the PJM fuel mix during the twelve months ending in November 2017.[26] (See Figure 5 below.)

<u>Natural Gas</u>

Natural gas prices are significantly below 2008 levels when the Henry Hub price averaged $8.94 per one million British Thermal Units (MMBtu).[27] Recently, the spot price has recovered from the lows reached in early 2012 when it briefly touched $2 per MMBtu.

Natural gas prices in the spot market result from the interaction of trends in domestic production, growing gas-fired generation, and winter heating needs.

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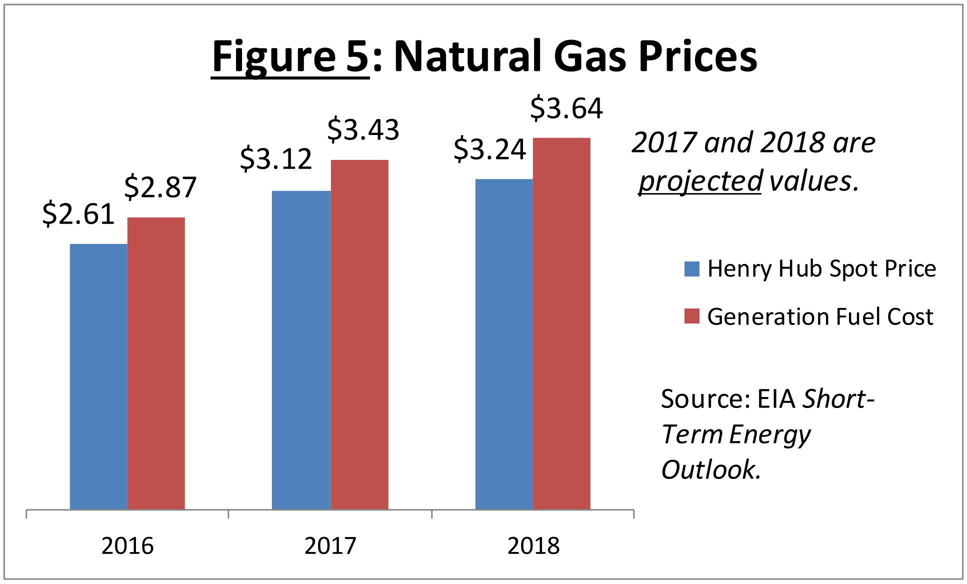
21 *EIA Monthly Energy Report*; June 2016; Table 3.1; page 49; http://www.eia.gov/totalenergy/data/monthly/pdf/mer.pdf. *STEO*; Table 4a.
22 *STEO*, Table 4a.
23 *STEO*; page 1.
24 *STEO*; page 1 and Table 2.
25 *STEO*, Tables 3b and 3c; page 4.
26 See PJM System Mix by Fuel; https://gats.pjm-eis.com/gats2/PublicReports/PJMSystemMix/Filter.
27 EIA; *2011 Annual Energy Outlook*; page 115.

In November, the average Henry Hub natural gas spot price was $3.01 per MMBtu, up fourteen cents from the October level.[28] Starting from the historical average of $2.61/MMBtu in 2016, EIA forecasts Henry Hub spots prices of $3.12 for 2017 and $3.24 for 2018.[29]

The Henry Hub spot price is more volatile than the cost of natural gas actually paid by electricity generators where long-term contracts and hedging are typically involved. EIA projects that the cost of natural gas for power generation will increase by 16 percent in 2017 followed by an increase of six percent in 2018.[30]



U.S. liquefied natural gas (LNG) export capcity is growing. Sabine Pass LNG (Texas) began export operations in February 2016; Cove Point LNG (Maryland) is expected to come on line this year. Natural gas liquefaction capacity from all projects currently under construction is projected to expand by 1.4 Bcf/d in 2017, 1.9 Bcf/d in 2018, and 2.8 Bcf/d in 2019. EIA expects exports to grow faster than production, putting modest upward pressure on natural-gas prices; EIA reports 0.51 billion cubic feet of LNG exports for 2016, projected to rise to 1.94 in 2017 and 3.03 in 2018. [31]

Because natural-gas prices are expected to rise (see Figure 5 above), wholesale electricity prices may rise as well in 2017 and 2018. However, regional variations in natural-gas prices are also a factor – influenced by local gas production and the availability of gas pipeline transportation capacity. The *Wall Street Journal* reports that plentiful natural gas in the Appalachian region has fueled an expansion of gas-fired generation and depressed electricity prices in the PJM wholesale market.[32]

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28 *STEO*; page 2. "Henry Hub" refers to a distribution hub on the natural gas pipeline system in Erath, Louisiana. It is used as the pricing point for natural gas futures contracts traded on the New York Mercantile Exchange.

29 *STEO*, Table 5b.

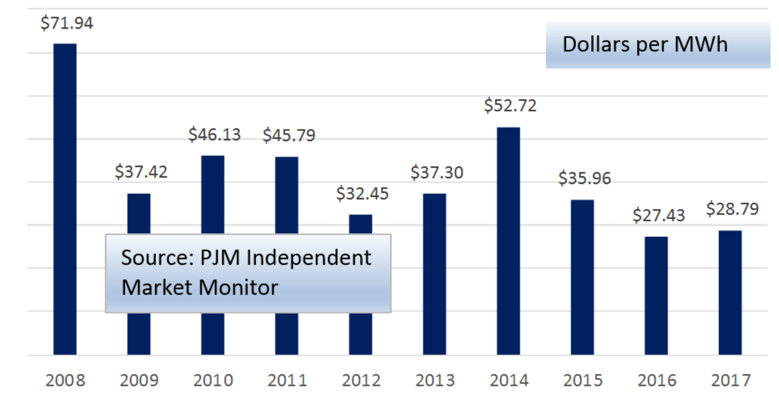
30 *STEO*; Table 7a.

31 See Table 5a and https://www.eia.gov/naturalgas/weekly/#jm-trends. "Bcf/d" is billion cubic feet per day.

32 "Power Plants Bloom Even as Electricity Prices Wilt," *Wall Street Journal*, December 28, 2017.

The impact of inexpensive natural gas can be seen easily in PJM price trends. Figure 6 (below) shows the average, load-weighted LMP for PJM since the peak of natural-gas prices in 2008; rising natural-gas prices in 2017 have had only a slight impact on the cost of generation in PJM (the 2014 average was impacted by the "Polar Vortex" – see above).[33]

Figure 6: PJM Average LMP (Jan-Sep)



Natural gas accounted for 26.3 percent of the PJM fuel mix during the twelve months ending in November 2017, a significant increase from 16.4 percent in June 2014.[34] (See Figure 5 below.)

Coal

Coal has been displaced by natural gas, wind, and nuclear in electricity generation. Nationwide, coal consumption in electric power generation has not returned to the peak level of 2007. EIA estimates that coal production declined to 728 million short tons (MMst) in 2016, the lowest level since 1978.[35] However, EIA expects that increased coal exports as well as higher natural gas prices will produce a eight percent rebound in coal production in 2017 followed by a slight decrease in 2018.[36]

EIA reports that the delivered price of coal for power generation peaked at $2.39 in 2011. EIA estimates the delivered price of coal averaged $2.11 per MMBtu in 2016 and forecasts $2.12 per MMBtu in 2017 and $2.20 in 2018.[37]

In the PJM wholesale market that serves the District of Columbia, the cost of natural gas is a more important factor than coal in setting the overall level of wholesale market prices for

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33 IMM 2017 Quarterly State of the Market Report for PJM: January through June; page 169.

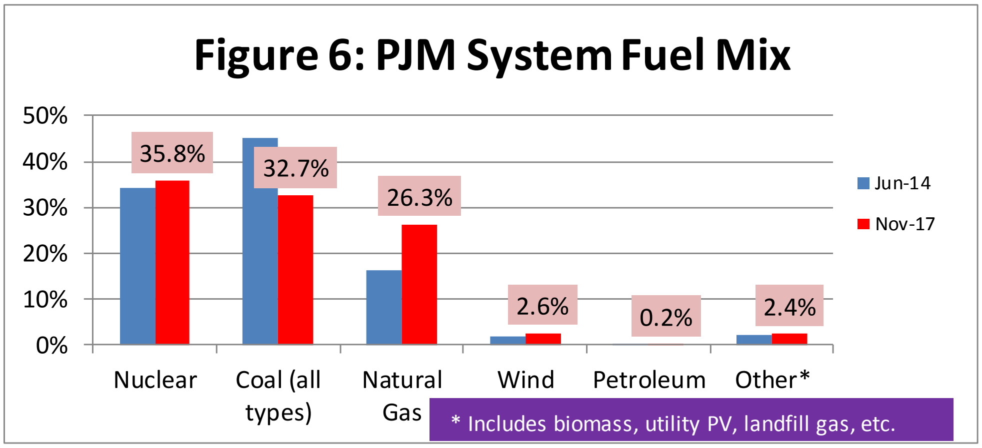
34 See PJM.

35 See Table 6.

36 *STEO*; Table 6. Historical data can be found at http://www.eia.gov/totalenergy/data/annual/pdf/sec7_9.pdf. See also The Brattle Group; Coal Plant Retirements: Feedback Effects on Wholesale Electricity Prices; November 2013; http://www.brattle.com/system/news/pdfs/000/000/584/original/Coal_Plant_Retirements_-_Feedback_Effects_on_Wholesale_Electricity_Prices.pdf.

37 *STEO*; Table 7a.

electricity.[38] Coal represented 32.7 percent of the PJM fuel mix during the twelve months ending in November 2017, down from a recent high of 45.2 percent in June 2014.[39] As noted above, the natural gas share of PJM generation is rising, in line with national trends. Furthermore, coal remains just behind nuclear as a share of the PJM fuel mix. (See Figure 6 below.)



Across the United States, coal generation plants are being retired and new natural gas-fired generation plants are being built, mirroring trends in the PJM region. On an annual basis, EIA projects that the 2016 natural gas share (34 percent) of electricity generation nationwide will fall to 32 percent in 2017 and 2018. Coal's share of generation is projected to rise from 30 percent in 2016 to 31 percent in 2017 and 2018.[40] EIA's forecasted generation shares for coal and natural gas are very sensitive to the natural-gas price forecast.

Renewables

Utility-scale solar still accounts for only 0.2 percent of installed capacity on the PJM system; however, it is growing at a rapid pace. During 2016, this capacity grew from 128 MW on January 1 to 262.3 MW by December 31.[41] This represents a growth rate of 105 percent for a single year. For comparison, wind represents 0.6 percent of PJM installed capacity and grew by 12 percent during 2016.

In line with capacity, generation from from solar (net metered and utility scale) is also growing quickly on the PJM system. In the first three quarters of 2016, solar generated 799.2 GWh which rose to 1,156.6 GWh in the same period of 2017. While the latter amount represents only 0.2 percent of total PJM generation, the rate of growth was substantial: 44.7 percent.[42]

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38 EIA reports prices for coal as delivered under long-term contracts that are less volatile than the spot prices reported for other fossil fuels. See Table 6, *STEO*.

39 See PJM.

40 *STEO;*page 2.

41 Independent Market Monitor 2017 Quarterly State of the Market Report for PJM: January through September; page 36.

42 IMM 2017 Quarterly State of the Market Report for PJM: January through September; Table 3-9; page 109.

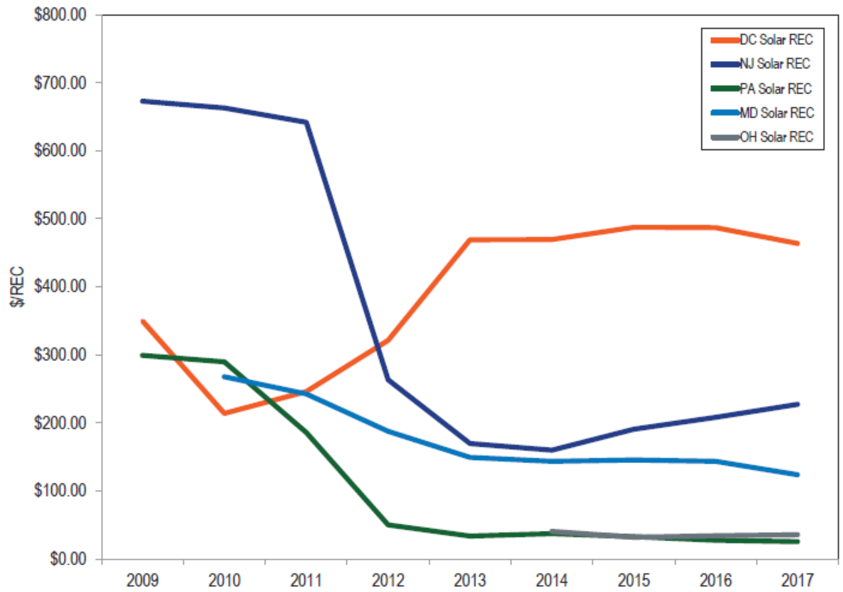
Renewable Portfolio Standards ("RPS") enacted by many states are stimulating the rapid growth of solar in the PJM market. This stimulus will intensify as scheduled increases will raise the RPS for solar in coming years, as shown in "Table 8-7" below.[43]

Table 8-7 Solar renewable standards by percent of electric load for PJM jurisdictions: 2017 to 2028

Jurisdiction with RPS	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Delaware	1.50%	1.75%	2.00%	2.25%	2.50%	2.75%	3.00%	3.25%	3.50%	3.50%	3.50%	3.50%
Illinois	0.69%	0.78%	0.87%	0.96%	1.05%	1.14%	1.23%	1.32%	1.41%	1.50%	1.50%	1.50%
Maryland	1.15%	1.50%	1.95%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Michigan	No Minimum Solar Requirement											
New Jersey	3.00%	3.20%	3.29%	3.38%	3.47%	3.56%	3.65%	3.74%	3.83%	3.92%	4.01%	4.10%
North Carolina	0.14%	0.20%	0.20%	0.20%	0.20%	0.20%	0.20%	0.20%	0.20%	0.20%	0.20%	0.20%
Ohio	0.15%	0.18%	0.22%	0.26%	0.30%	0.34%	0.38%	0.42%	0.46%	0.50%	0.50%	0.50%
Pennsylvania	0.29%	0.34%	0.39%	0.44%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Washington, D.C.	0.98%	1.15%	1.35%	1.58%	1.85%	2.18%	2.50%	2.60%	2.85%	3.15%	3.45%	3.75%
Jurisdiction with Voluntary Standard												
Indiana	No Minimum Solar Requirement											
Virginia	No Minimum Solar Requirement											
Jurisdiction with No Standard												
Kentucky	No Renewable Portfolio Standard											
Tennessee	No Renewable Portfolio Standard											
West Virginia	No Renewable Portfolio Standard											

Prices for Solar Renewable Energy Credits ("SRECs") are much higher in the District of Columbia than in neighboring jurisdictions, as can be seen in "Figure 8-5" below.[44]

Figure 8-5 Average SREC price by jurisdiction: January 1, 2009 through September 30, 2017



116 Solar REC average price information obtained through Evomarkets, <http://www.evomarkets.com> (Accessed October 24, 2017).

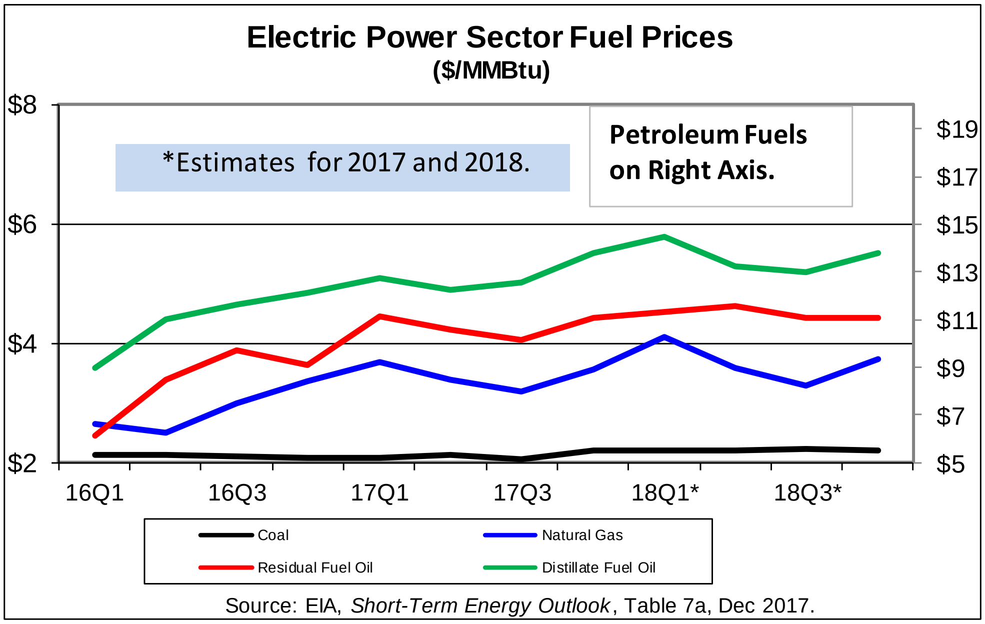
43 IMM 2017 Quarterly State of the Market Report for PJM: January through September; page 322.

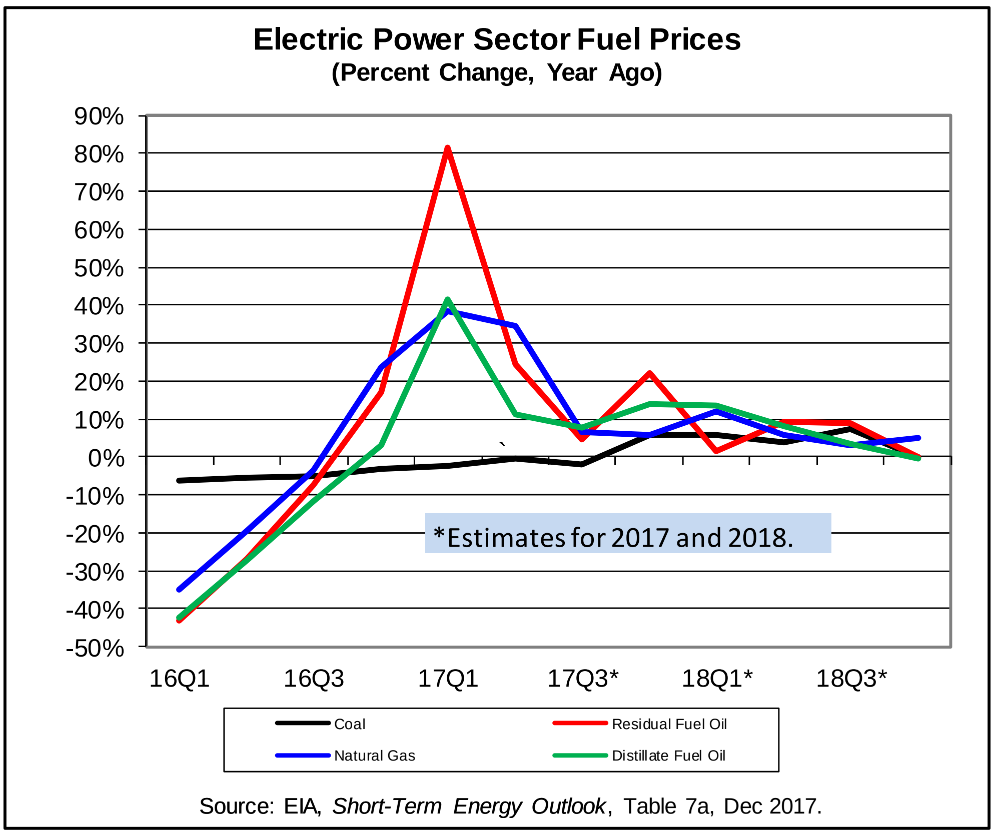
44 IMM 2017 Quarterly State of the Market Report for PJM: January through September; page 328.

EIA reports that solar capacity is also growing rapidly nationwide, with utility-scale solar expected to grow by 37 percent from 2016 to 2018. At that rate, utility-scale solar will be more than one percent of electricity generation capacity in 2018. Wind capacity is growing rapidly as well, increasing by 18 percent during 2016-2018.[45]

Nationwide, EIA projects that generation of electricity from renewable sources (other than hydropower) will grow from eight percent in 2016 to nine percent in 2017 and 10 percent in 2018.[46]

[45] *STEO*; page 2.
[46] *STEO* at page 2.


Electric Power Sector Fuel Prices
($/MMBtu)
*Estimates for 2017 and 2018.
Petroleum Fuels on Right Axis.
$8
$6
$4
$2
$19
$17
$15
$13
$11
$9
$7
$5
16Q1
16Q3
17Q1
17Q3
18Q1*
18Q3*
Coal
Natural Gas
Residual Fuel Oil
Distillate Fuel Oil
Source: EIA, Short-Term Energy Outlook, Table 7a, Dec 2017.


Electric Power Sector Fuel Prices
(Percent Change, Year Ago)
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
-10%
-20%
-30%
-40%
-50%
*Estimates for 2017 and 2018.
16Q1
16Q3
17Q1
17Q3*
18Q1*
18Q3*
Coal
Residual Fuel Oil
Natural Gas
Distillate Fuel Oil
Source: EIA, Short-Term Energy Outlook, Table 7a, Dec 2017.

Wholesale Electric Market Assessment Information

Price of Electricity Futures Contracts for November 26 and December 12, 2017

Twelve Month NYMEX Strip Components[47]

$/MWh (for $/kWh, divide by 1000)

	Nov-17	Dec-17
Jan-18	**$ 44.65**	**$ 43.10**
Feb-18	**$ 44.55**	**$ 43.00**
Mar-18	**$ 37.85**	**$ 36.55**
Apr-18	**$ 33.95**	**$ 33.50**
May-18	**$ 33.95**	**$ 33.50**
Jun-18	**$ 34.50**	**$ 33.75**
Jul-18	**$ 39.25**	**$ 38.40**
Aug-18	**$ 36.40**	**$ 35.55**
Sep-18	**$ 34.00**	**$ 33.55**
Oct-18	**$ 32.40**	**$ 32.00**
Nov-18	**$ 32.55**	**$ 32.20**
Dec-18	**$ 34.55**	**$ 35.00**
Jan-19	**$ 47.40**	**$ 46.10**

PEPCO DC Zone Locational Marginal Price (Hourly Integrated LMP for the hour ending 1500[48]

December 11, 2017: **$26.80**

The above are wholesale energy prices only. Transmission and distribution rates are not included.

Weather Forecast

1. Current for next few days to one week:

http://www.cnn.com/Weather/

http://home.accuweather.com/

2. National Oceanic and Atmospheric Administration, Climate Prediction Center Outlook:

http://www.cpc.ncep.noaa.gov/

[47] http://www.cmegroup.com/trading/energy/electricity/pjm-western-hub-peak-calendar-month-real-time-lmp.html.

[48] http://ftp.pjm.com/pub/account/lmpgen/lmppost.html.