

2017 Year in Review

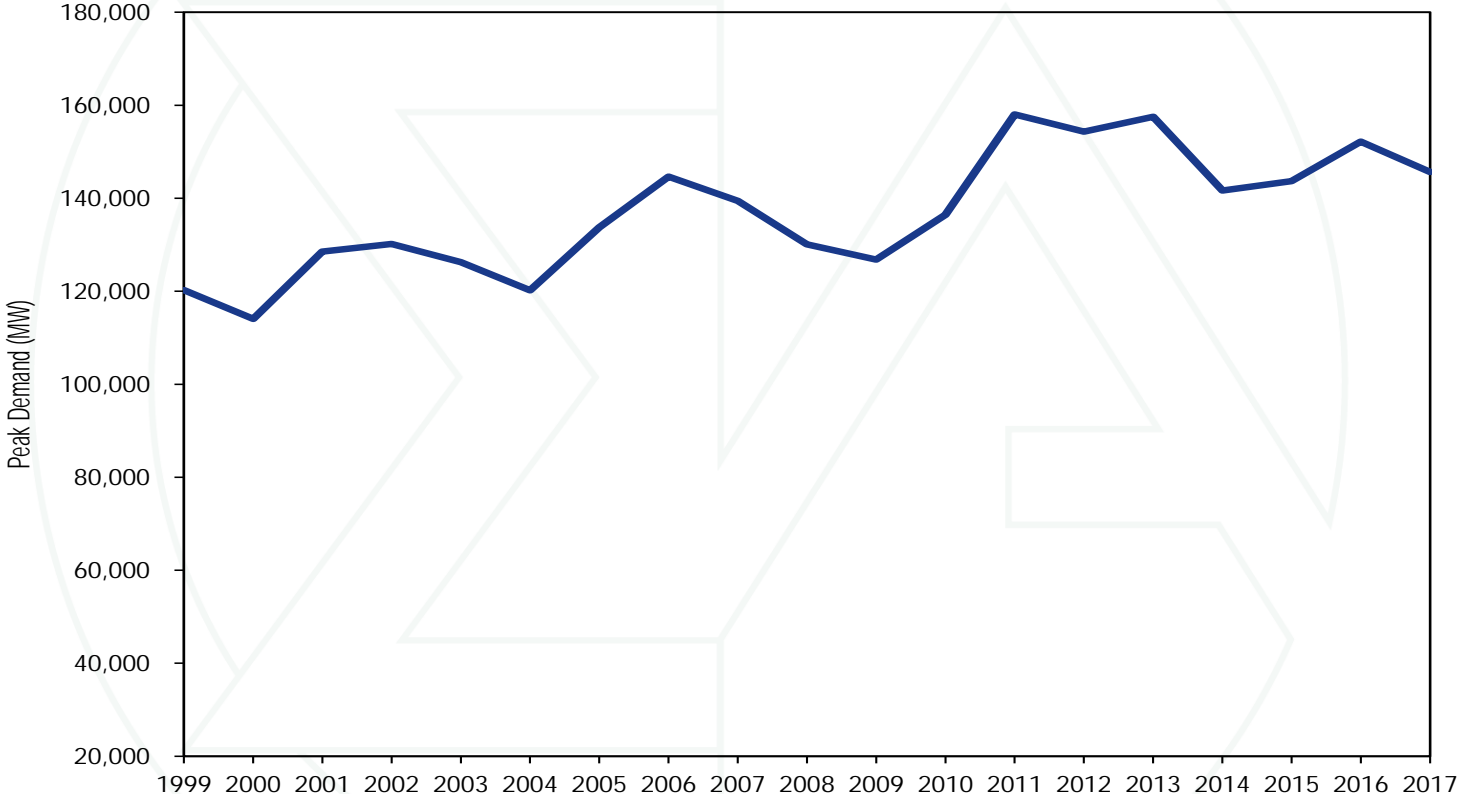
PJM Annual Meeting
May 16, 2018

Joe Bowring

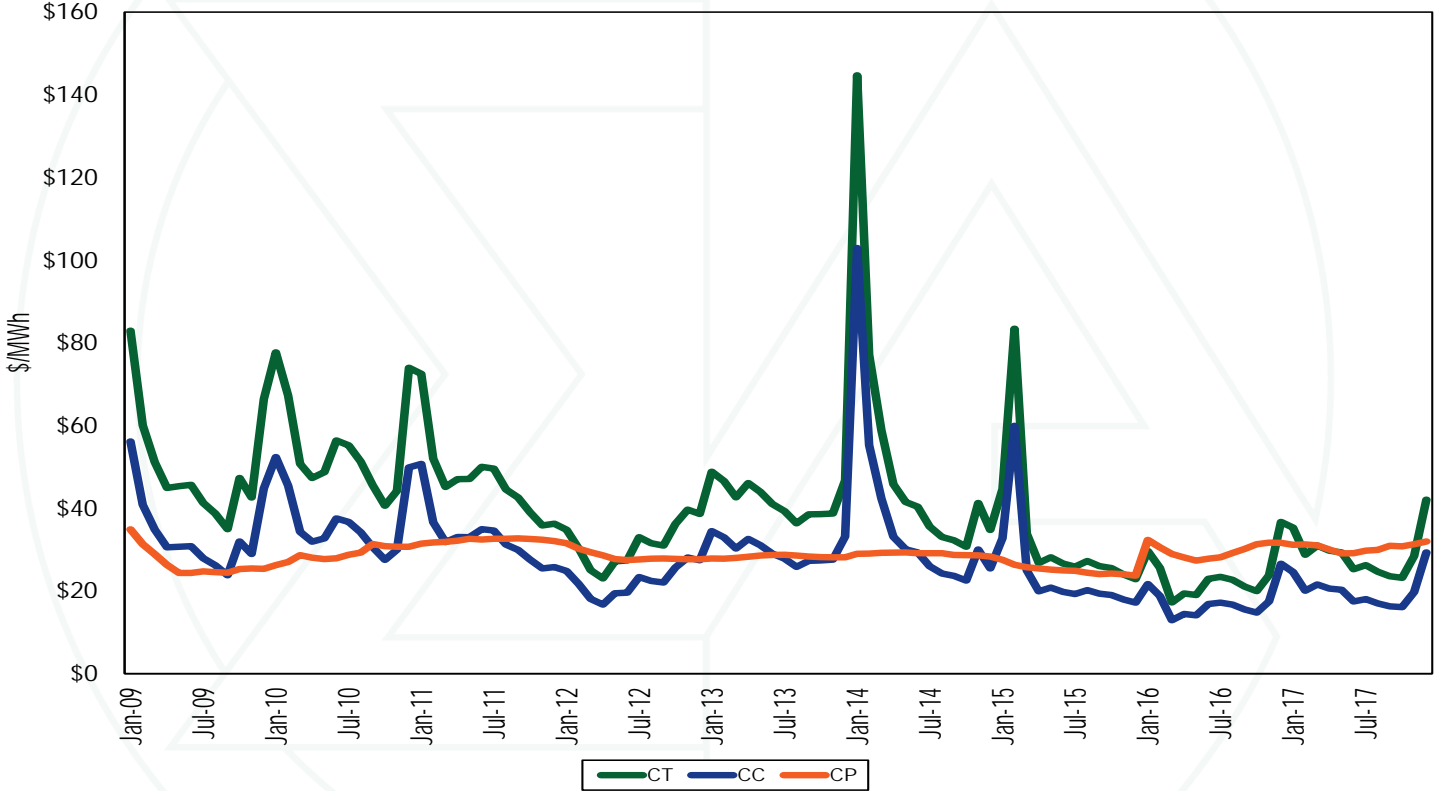


Monitoring Analytics

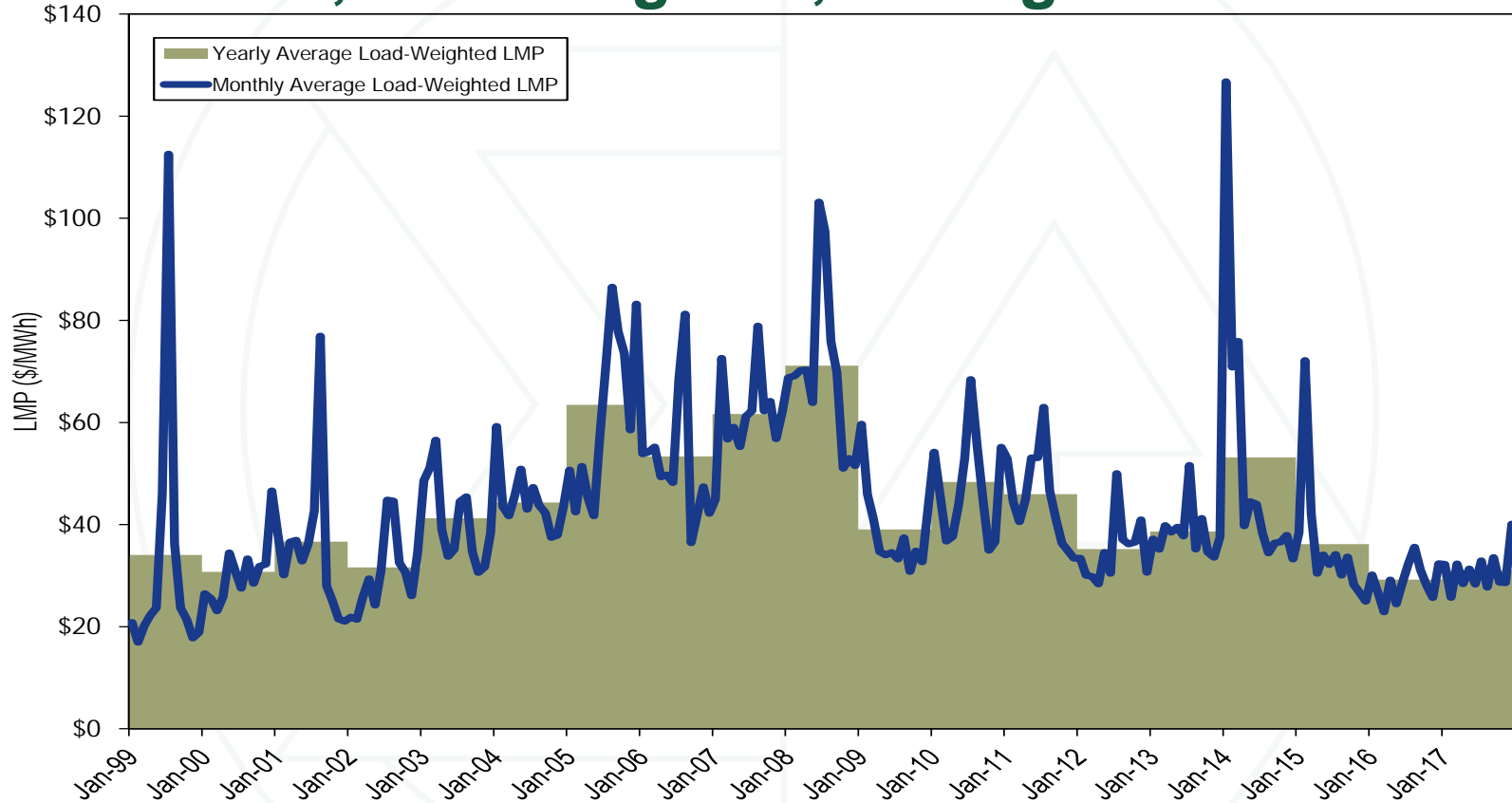
Peak load: 1999 to 2017



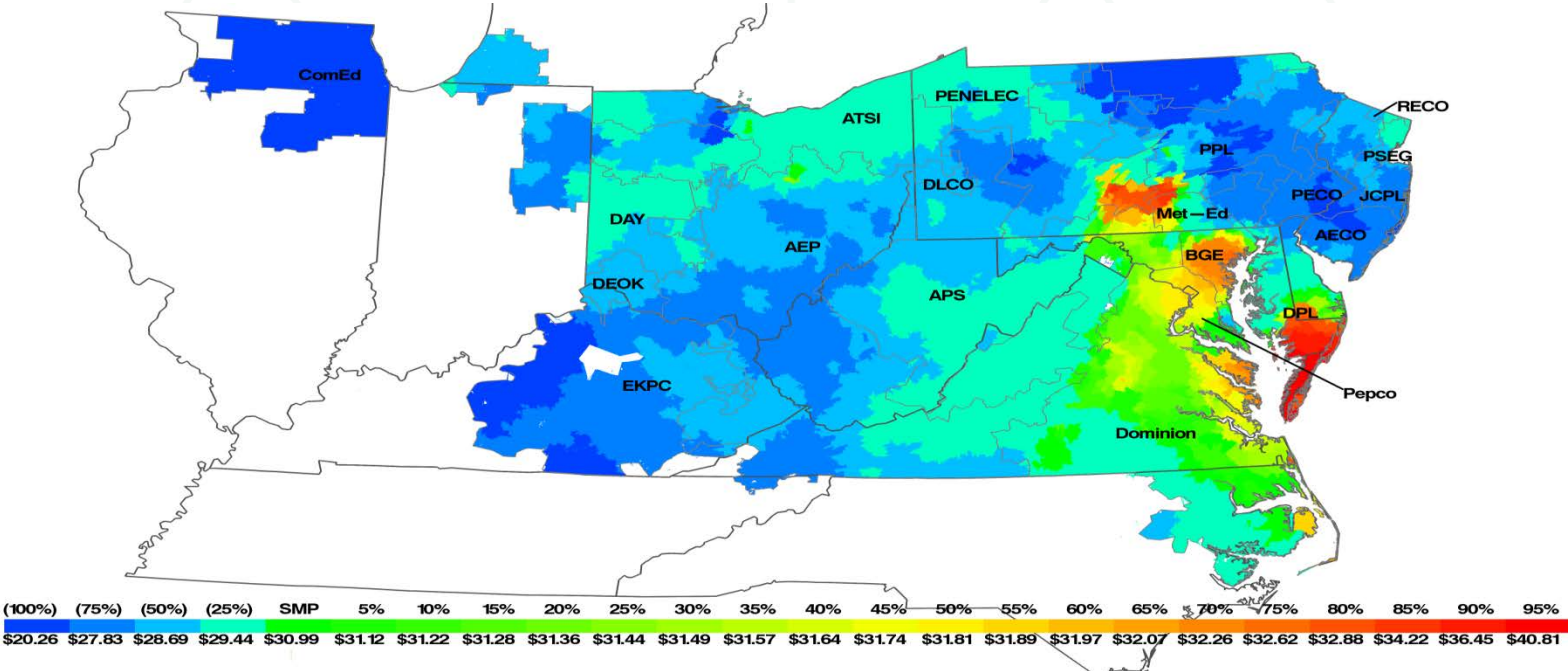
Average short run marginal costs



Real-time, load-weighted, average LMP



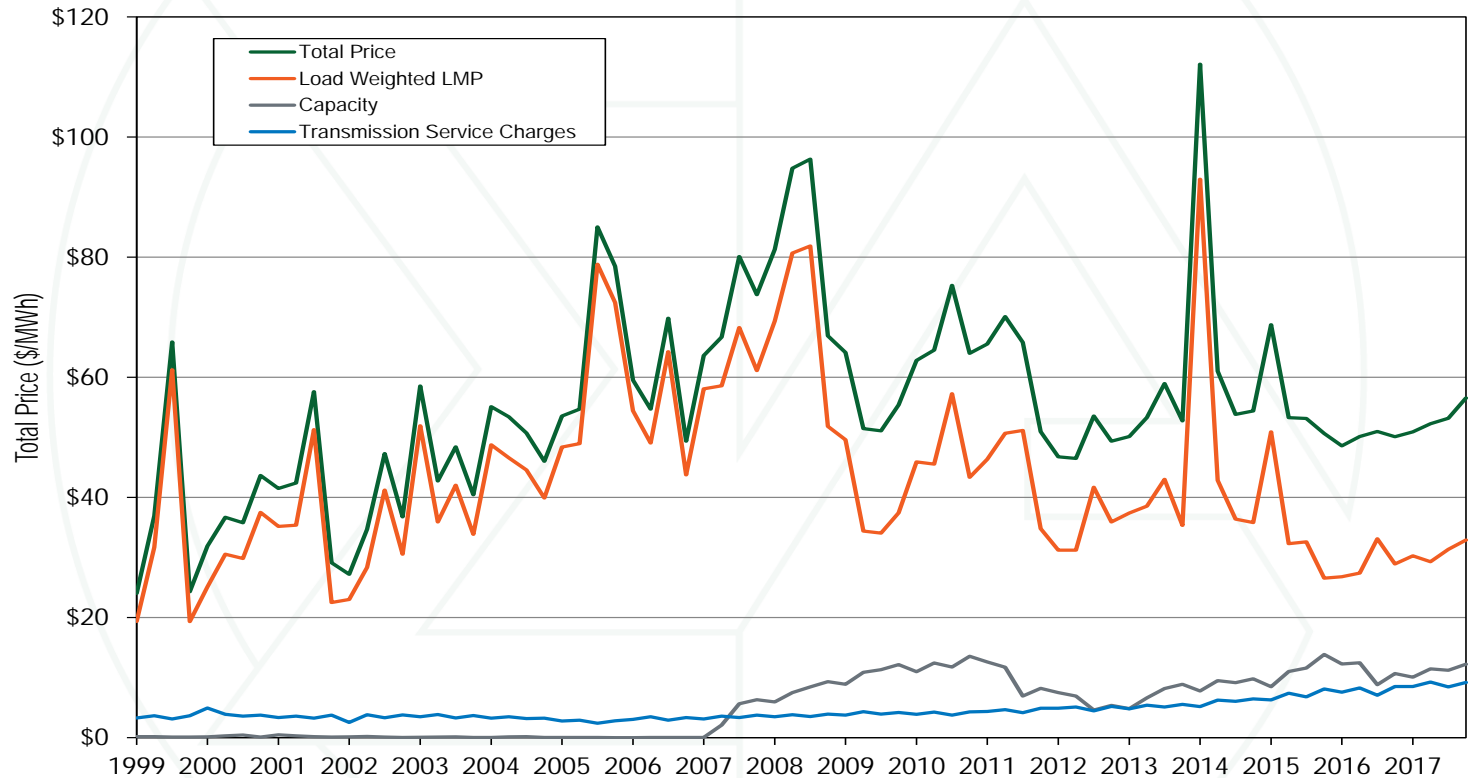
Real-time, load-weighted, average LMP



Components of PJM real-time LMP

| Element | 2016 | | 2017 | | Change |
|-----------------------------------|---------------------|---------|---------------------|---------|---------|
| | Contribution to LMP | Percent | Contribution to LMP | Percent | Percent |
| Gas | \$7.76 | 26.5% | \$12.15 | 39.2% | 12.7% |
| Coal | \$13.44 | 46.0% | \$8.97 | 28.9% | (17.0%) |
| Markup | \$0.27 | 0.9% | \$2.55 | 8.2% | 7.3% |
| Ten Percent Adder | \$2.43 | 8.3% | \$2.39 | 7.7% | (0.6%) |
| VOM | \$2.04 | 7.0% | \$1.70 | 5.5% | (1.5%) |
| NA | \$1.48 | 5.1% | \$0.81 | 2.6% | (2.5%) |
| LPA Rounding Difference | \$0.15 | 0.5% | \$0.78 | 2.5% | 2.0% |
| Oil | \$0.24 | 0.8% | \$0.44 | 1.4% | 0.6% |
| NO _x Cost | \$0.42 | 1.4% | \$0.41 | 1.3% | (0.1%) |
| Increase Generation Adder | \$0.41 | 1.4% | \$0.39 | 1.2% | (0.2%) |
| Ancillary Service Redispatch Cost | \$0.32 | 1.1% | \$0.25 | 0.8% | (0.3%) |
| CO ₂ Cost | \$0.09 | 0.3% | \$0.09 | 0.3% | (0.0%) |
| SO ₂ Cost | \$0.07 | 0.3% | \$0.06 | 0.2% | (0.1%) |
| Other | \$0.15 | 0.5% | \$0.06 | 0.2% | (0.3%) |
| Scarcity Adder | \$0.00 | 0.0% | \$0.05 | 0.2% | 0.2% |
| Municipal Waste | \$0.04 | 0.1% | \$0.05 | 0.2% | 0.0% |
| Opportunity Cost Adder | \$0.00 | 0.0% | \$0.04 | 0.1% | 0.1% |
| Market-to-Market Adder | \$0.01 | 0.0% | \$0.00 | 0.0% | (0.0%) |
| Uranium | \$0.00 | 0.0% | \$0.00 | 0.0% | (0.0%) |
| Constraint Violation Adder | \$0.00 | 0.0% | \$0.00 | 0.0% | 0.0% |
| LPA-SCED Differential | (\$0.01) | (0.0%) | (\$0.01) | (0.0%) | 0.0% |
| Decrease Generation Adder | (\$0.03) | (0.1%) | (\$0.07) | (0.2%) | (0.1%) |
| Wind | (\$0.05) | (0.2%) | (\$0.11) | (0.4%) | (0.2%) |
| Total | \$29.23 | 100.0% | \$30.99 | 100.0% | 0.0% |

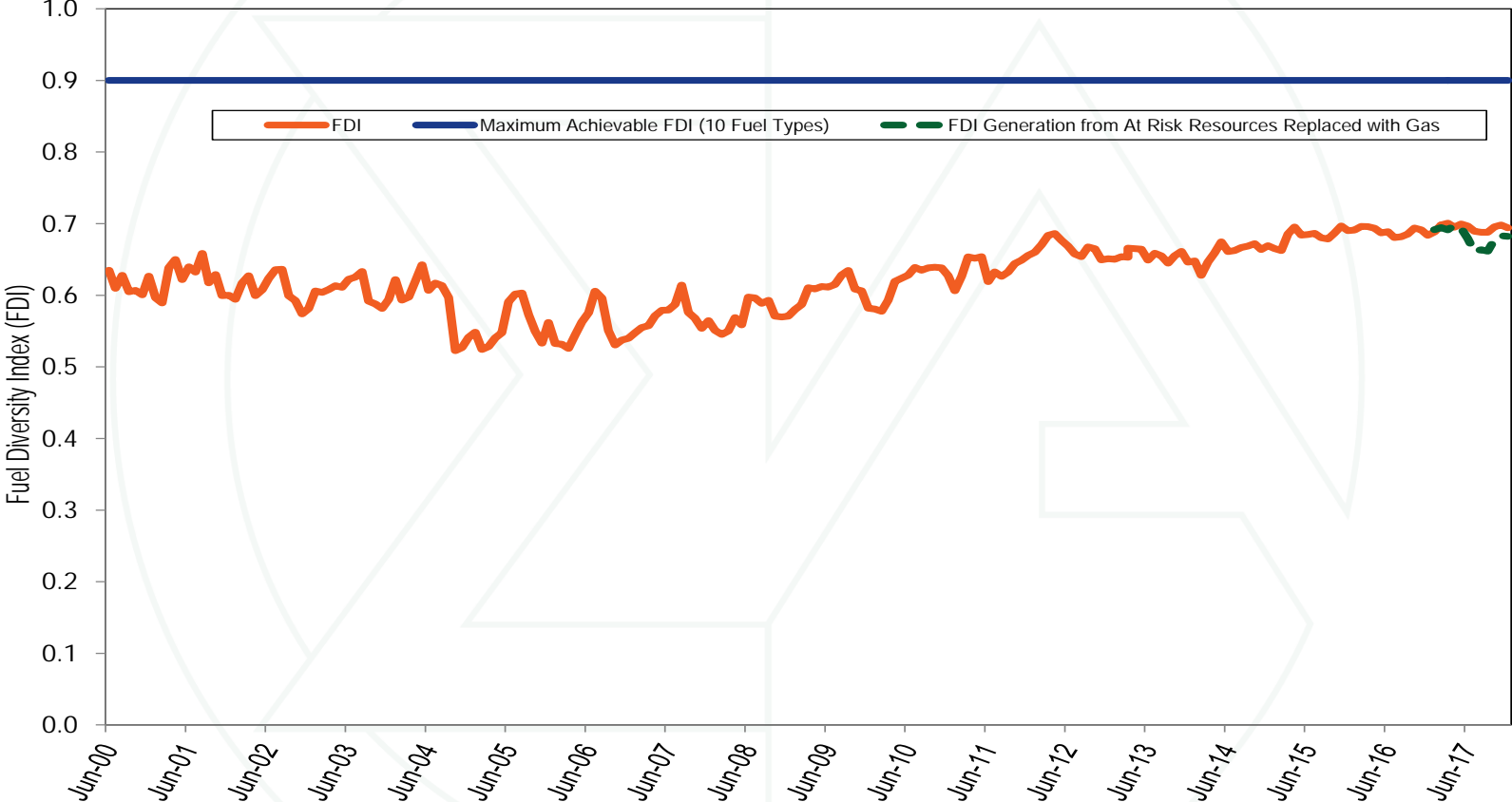
Top three components of total wholesale price



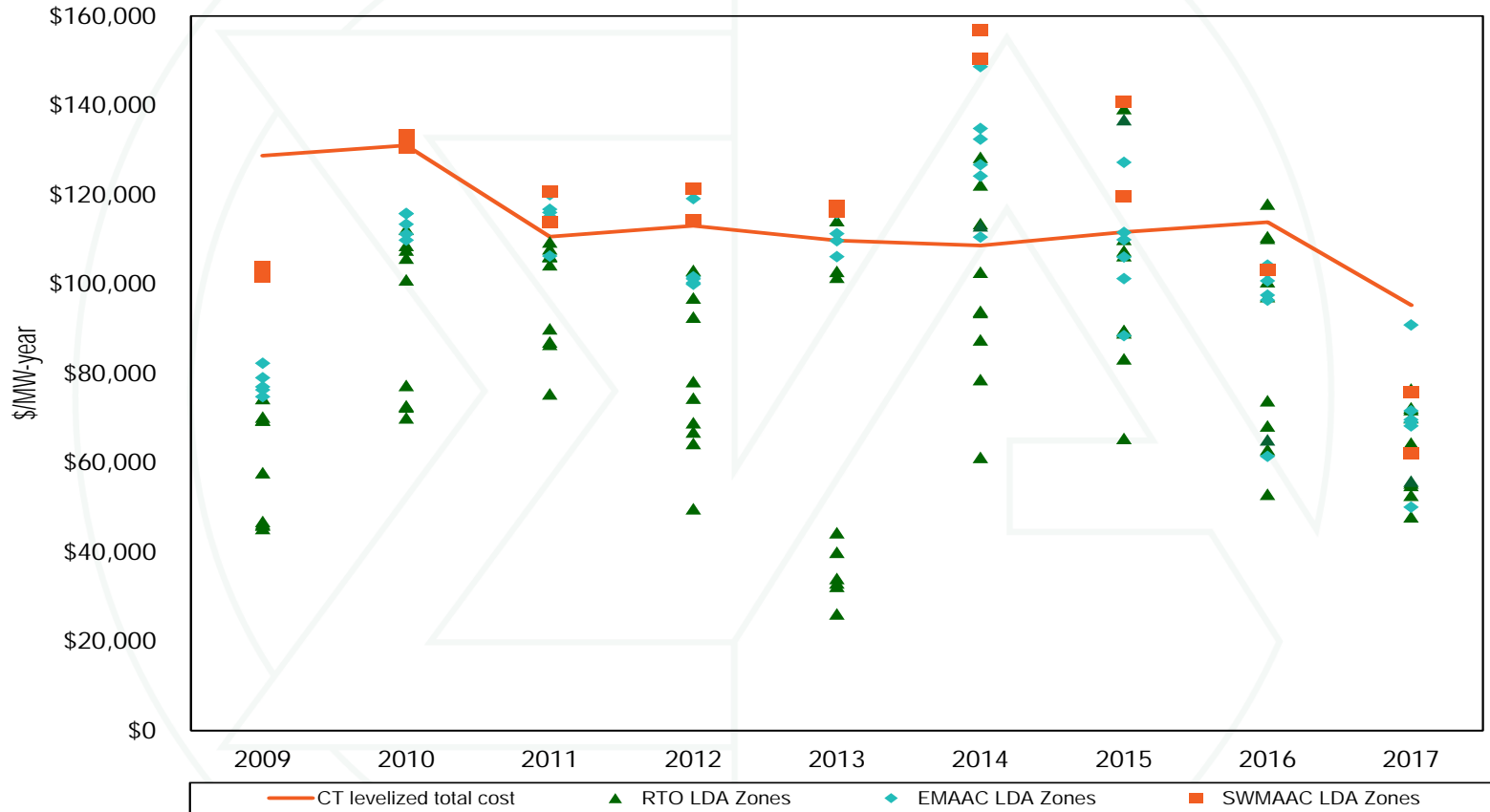
PJM generation by fuel source

| | 2016 | | 2017 | | Change in Output |
|----------------------------|------------------|---------------|------------------|---------------|------------------|
| | GWh | Percent | GWh | Percent | |
| Coal | 275,289.4 | 33.9% | 256,613.8 | 31.8% | (6.8%) |
| Bituminous | 241,050.2 | 29.7% | 220,789.4 | 27.3% | (8.4%) |
| Sub Bituminous | 28,949.8 | 3.6% | 28,016.0 | 3.5% | (3.2%) |
| Other Coal | 5,289.5 | 0.7% | 7,808.4 | 1.0% | 47.6% |
| Nuclear | 279,546.4 | 34.4% | 287,575.8 | 35.6% | 2.9% |
| Gas | 217,199.0 | 26.7% | 219,205.1 | 27.1% | 0.9% |
| Natural Gas | 215,021.4 | 26.5% | 216,758.6 | 26.8% | 0.8% |
| Landfill Gas | 2,177.6 | 0.3% | 2,433.1 | 0.3% | 11.7% |
| Other Gas | 0.0 | 0.0% | 13.4 | 0.0% | NA |
| Hydroelectric | 13,686.8 | 1.7% | 14,868.4 | 1.8% | 8.6% |
| Pumped Storage | 4,840.2 | 0.6% | 5,132.6 | 0.6% | 6.0% |
| Run of River | 7,332.8 | 0.9% | 8,119.8 | 1.0% | 10.7% |
| Other Hydro | 1,513.8 | 0.2% | 1,616.0 | 0.2% | 6.8% |
| Wind | 17,716.0 | 2.2% | 20,714.1 | 2.6% | 16.9% |
| Waste | 4,358.9 | 0.5% | 3,984.1 | 0.5% | (8.6%) |
| Solid Waste | 4,139.8 | 0.5% | 3,740.7 | 0.5% | (9.6%) |
| Miscellaneous | 219.2 | 0.0% | 243.4 | 0.0% | 11.1% |
| Oil | 2,163.2 | 0.3% | 2,301.7 | 0.3% | 6.4% |
| Heavy Oil | 270.7 | 0.0% | 174.4 | 0.0% | (35.6%) |
| Light Oil | 340.7 | 0.0% | 340.3 | 0.0% | (0.1%) |
| Diesel | 59.4 | 0.0% | 81.7 | 0.0% | 37.5% |
| Gasoline | 0.0 | 0.0% | 0.0 | 0.0% | NA |
| Kerosene | 74.8 | 0.0% | 15.2 | 0.0% | (79.6%) |
| Jet Oil | 0.0 | 0.0% | 3.1 | 0.0% | NA |
| Other Oil | 1,417.7 | 0.2% | 1,687.0 | 0.2% | 19.0% |
| Solar, Net Energy Metering | 1,019.4 | 0.1% | 1,468.7 | 0.2% | 44.1% |
| Energy Storage | 15.7 | 0.0% | 25.1 | 0.0% | 59.6% |
| Battery | 15.7 | 0.0% | 25.1 | 0.0% | 59.6% |
| Compressed Air | 0.0 | 0.0% | 0.0 | 0.0% | NA |
| Biofuel | 1,541.5 | 0.2% | 1,473.0 | 0.2% | (4.4%) |
| Geothermal | 0.0 | 0.0% | 0.0 | 0.0% | NA |
| Other Fuel Type | 0.0 | 0.0% | 0.0 | 0.0% | NA |
| Total | 812,536.3 | 100.0% | 808,229.7 | 100.0% | (0.5%) |

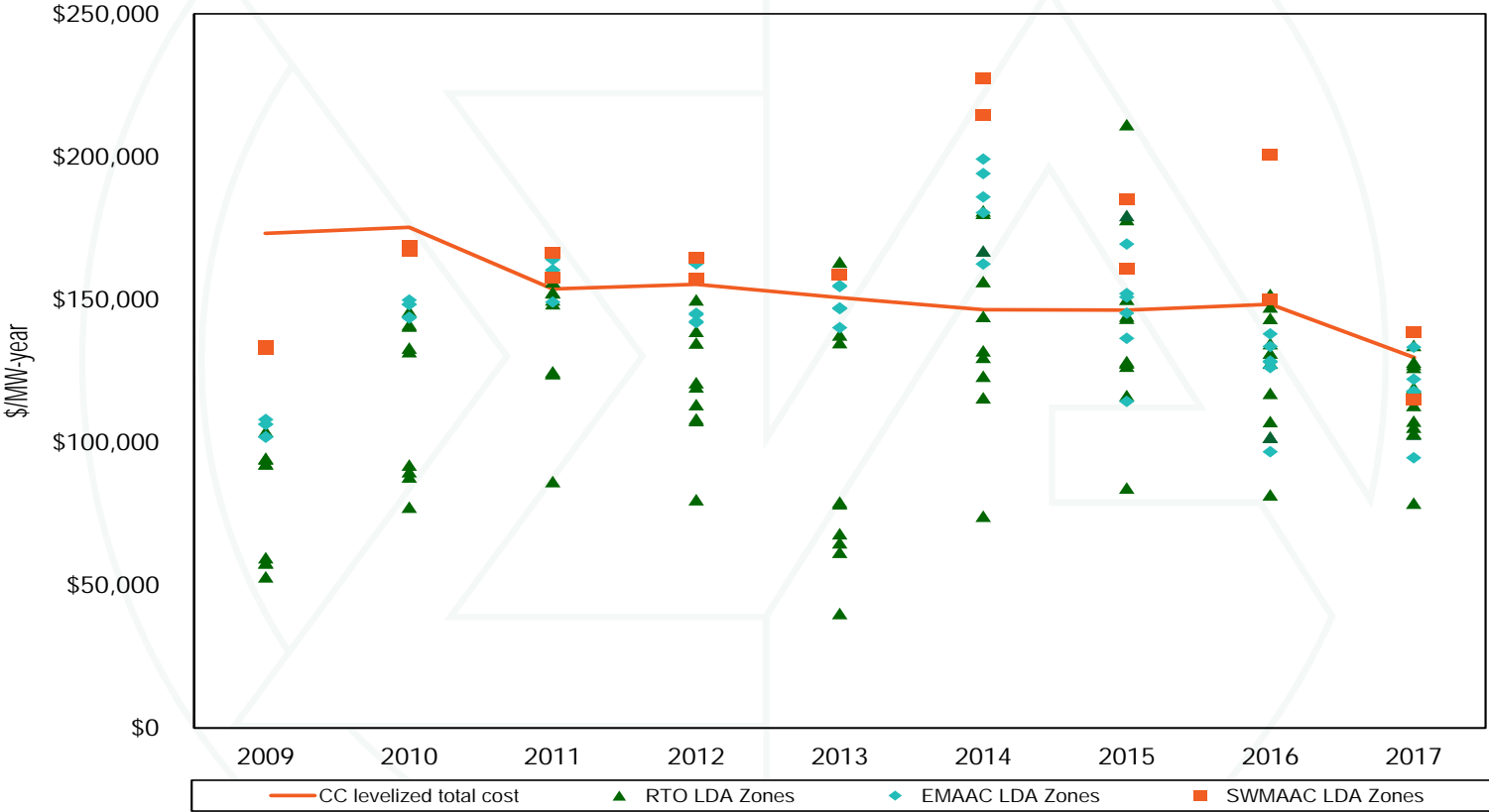
Generation fuel diversity index



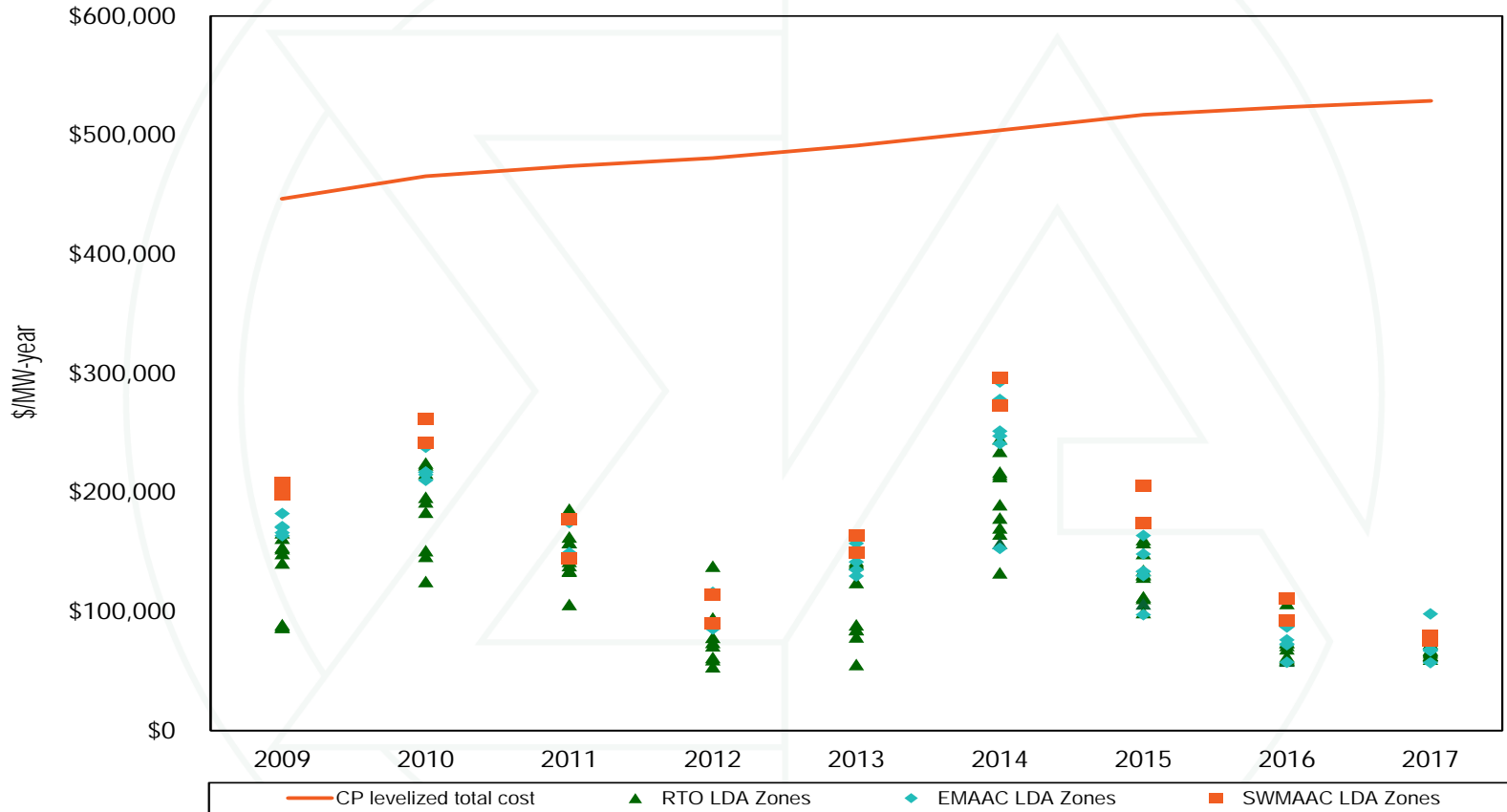
New entrant CT net revenue and total cost



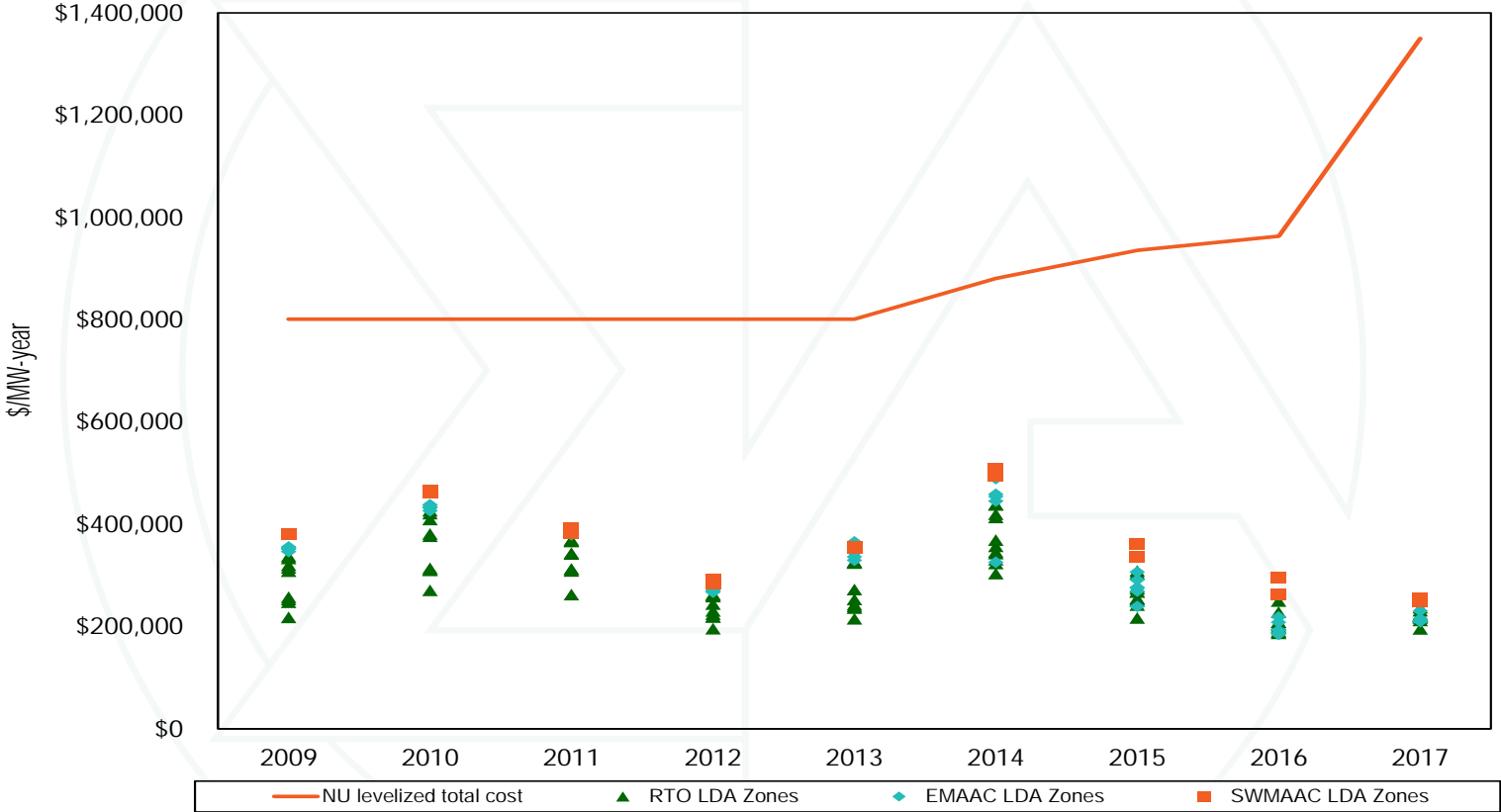
New entrant CC net revenue and total cost



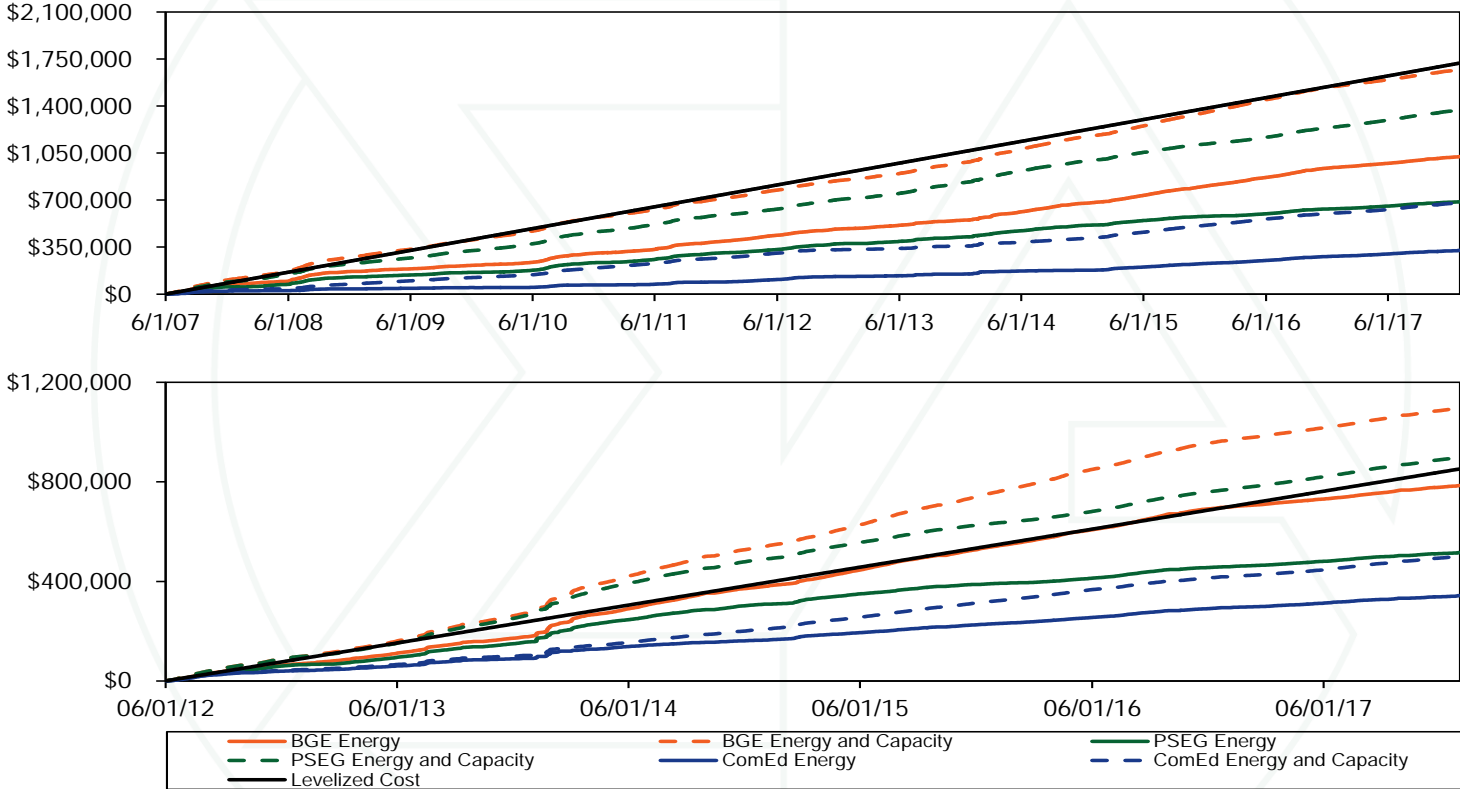
New entrant coal net revenue and total cost



New entrant nuclear net revenue and total cost



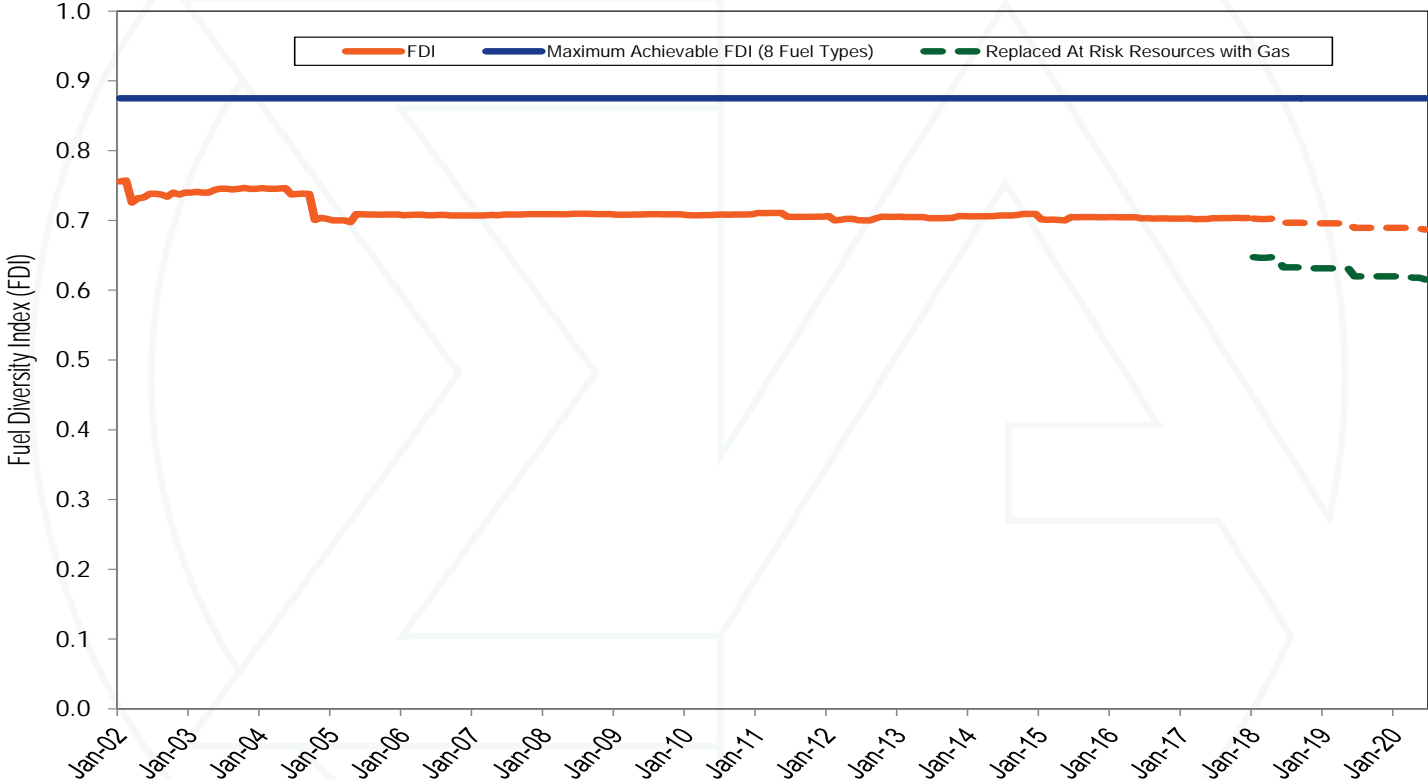
Historical new entrant CC revenue adequacy



PJM installed capacity (by fuel source)

| | 1-Jan-17 | | 31-May-17 | | 1-Jun-17 | | 31-Dec-17 | |
|---------------|-----------|---------|-----------|---------|-----------|---------|-----------|---------|
| | MW | Percent | MW | Percent | MW | Percent | MW | Percent |
| Coal | 66,622.2 | 36.5% | 66,941.3 | 36.5% | 65,688.0 | 35.9% | 65,144.0 | 35.4% |
| Gas | 65,110.3 | 35.7% | 65,787.1 | 35.9% | 66,397.6 | 36.3% | 67,726.4 | 36.8% |
| Hydroelectric | 8,850.4 | 4.9% | 8,850.4 | 4.8% | 8,870.2 | 4.8% | 8,856.2 | 4.8% |
| Nuclear | 33,043.4 | 18.1% | 33,103.7 | 18.0% | 33,163.5 | 18.1% | 33,163.5 | 18.0% |
| Oil | 6,733.6 | 3.7% | 6,687.0 | 3.6% | 6,684.4 | 3.7% | 6,672.2 | 3.6% |
| Solar | 262.3 | 0.1% | 268.0 | 0.1% | 366.8 | 0.2% | 373.2 | 0.2% |
| Solid waste | 769.4 | 0.4% | 769.4 | 0.4% | 814.4 | 0.4% | 809.4 | 0.4% |
| Wind | 1,019.1 | 0.6% | 1,079.1 | 0.6% | 1,114.3 | 0.6% | 1,136.7 | 0.6% |
| Total | 182,410.7 | 100.0% | 183,486.0 | 100.0% | 183,099.2 | 100.0% | 183,881.6 | 100.0% |

Installed capacity fuel diversity index



Avoidable cost recovery: 2011 through 2017

| Technology | Units with full recovery from energy and ancillary net revenue | | | | | | | Units with full recovery from all markets | | | | | | |
|-----------------------|--|------|------|------|------|------|------|---|------|------|------|------|------|------|
| | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
| CC - Combined Cycle | 55% | 46% | 50% | 72% | 59% | 63% | 62% | 85% | 79% | 79% | 95% | 88% | 93% | 86% |
| CT - Aero Derivative | 15% | 6% | 6% | 53% | 15% | 8% | 23% | 100% | 96% | 76% | 98% | 100% | 99% | 99% |
| CT - Industrial Frame | 26% | 23% | 17% | 38% | 13% | 8% | 18% | 99% | 98% | 83% | 100% | 100% | 100% | 99% |
| Coal Fired | - | - | 25% | 78% | 18% | 19% | 19% | - | - | 54% | 83% | 69% | 40% | 52% |
| Diesel | 48% | 42% | 37% | 69% | 56% | 33% | 46% | 100% | 100% | 77% | 100% | 100% | 100% | 100% |
| Hydro | 74% | 61% | 95% | 97% | 81% | 79% | 95% | 81% | 77% | 97% | 98% | 100% | 100% | 97% |
| Nuclear | - | - | 79% | 100% | 53% | 16% | 21% | - | - | 95% | 100% | 89% | 58% | 68% |
| Oil or Gas Steam | 8% | 6% | 11% | 15% | 3% | 0% | 9% | 92% | 78% | 86% | 85% | 91% | 88% | 88% |
| Pumped Storage | 100% | 100% | 95% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |

Nuclear unit historic annual surplus (shortfall)

| | ICAP (MW) | Surplus (Shortfall) (\$/MWh) | | | | | | | | | | | | | | |
|-------------------|--------------|------------------------------|--------|---------|----------|---------|--------------------------|--------|---------|---------|---------|--------------------------|--------|---------|---------|---------|
| | | 100% of NEI Capital Costs | | | | | 2/3 of NEI Capital Costs | | | | | 1/3 of NEI Capital Costs | | | | |
| | | 2013 | 2014 | 2015 | 2016 | 2017 | 2013 | 2014 | 2015 | 2016 | 2017 | 2013 | 2014 | 2015 | 2016 | 2017 |
| Beaver Valley | 1,777 | \$3.6 | \$13.8 | \$4.2 | (\$0.8) | \$1.4 | \$5.6 | \$15.8 | \$6.3 | \$1.3 | \$3.5 | \$7.7 | \$17.9 | \$8.3 | \$3.3 | \$5.5 |
| Braidwood | 2,330 | (\$0.4) | \$9.3 | (\$0.2) | (\$3.5) | (\$2.7) | \$1.6 | \$11.3 | \$1.9 | (\$1.5) | (\$0.6) | \$3.7 | \$13.4 | \$3.9 | \$0.6 | \$1.4 |
| Byron | 2,300 | (\$1.5) | \$7.0 | (\$5.1) | (\$9.9) | (\$3.9) | \$0.6 | \$9.0 | (\$3.1) | (\$7.8) | (\$1.8) | \$2.6 | \$11.1 | (\$1.0) | (\$5.8) | \$0.2 |
| Calvert Cliffs | 1,716 | \$16.4 | \$33.5 | \$15.1 | \$6.8 | \$4.9 | \$18.5 | \$35.5 | \$17.2 | \$8.9 | \$7.0 | \$20.5 | \$37.6 | \$19.2 | \$10.9 | \$9.0 |
| Cook | 2,071 | \$3.5 | \$12.4 | \$3.8 | (\$0.9) | \$0.3 | \$5.5 | \$14.5 | \$5.8 | \$1.2 | \$2.4 | \$7.6 | \$16.5 | \$7.9 | \$3.2 | \$4.4 |
| Davis Besse | 894 | (\$4.3) | \$9.4 | \$1.4 | (\$4.6) | (\$7.6) | (\$1.4) | \$12.2 | \$4.3 | (\$1.7) | (\$4.8) | \$1.5 | \$15.1 | \$7.2 | \$1.2 | (\$1.9) |
| Dresden | 1,787 | \$1.2 | \$11.1 | \$1.3 | (\$1.9) | (\$1.3) | \$3.2 | \$13.2 | \$3.4 | \$0.1 | \$0.7 | \$5.3 | \$15.2 | \$5.4 | \$2.2 | \$2.8 |
| Hope Creek | 1,161 | \$14.2 | \$27.9 | \$7.2 | (\$2.6) | \$0.1 | \$16.2 | \$30.0 | \$9.3 | (\$0.6) | \$2.2 | \$18.3 | \$32.0 | \$11.3 | \$1.5 | \$4.2 |
| LaSalle | 2,238 | \$0.3 | \$9.8 | \$0.1 | (\$3.9) | (\$3.0) | \$2.3 | \$11.8 | \$2.2 | (\$1.8) | (\$0.9) | \$4.4 | \$13.9 | \$4.2 | \$0.2 | \$1.1 |
| Limerick | 2,296 | \$14.0 | \$27.7 | \$7.5 | (\$2.5) | \$0.3 | \$16.1 | \$29.7 | \$9.5 | (\$0.4) | \$2.4 | \$18.1 | \$31.8 | \$11.6 | \$1.6 | \$4.4 |
| North Anna | 1,891 | \$7.9 | \$25.3 | \$11.9 | \$2.7 | \$3.6 | \$9.9 | \$27.3 | \$14.0 | \$4.7 | \$5.6 | \$12.0 | \$29.4 | \$16.0 | \$6.8 | \$7.7 |
| Oyster Creek | 615 | \$5.6 | \$19.0 | (\$1.9) | (\$11.8) | (\$8.9) | \$8.5 | \$21.9 | \$1.0 | (\$8.9) | (\$6.0) | \$11.4 | \$24.8 | \$3.9 | (\$6.0) | (\$3.1) |
| Quad Cities | 1,819 | (\$4.7) | \$2.6 | (\$6.7) | (\$9.8) | (\$4.6) | (\$2.7) | \$4.7 | (\$4.6) | (\$7.7) | (\$2.5) | (\$0.6) | \$6.7 | (\$2.6) | (\$5.7) | (\$0.5) |
| Peach Bottom | 2,251 | \$14.1 | \$27.5 | \$6.8 | (\$2.8) | \$0.1 | \$16.2 | \$29.5 | \$8.8 | (\$0.7) | \$2.2 | \$18.2 | \$31.6 | \$10.9 | \$1.3 | \$4.2 |
| Perry | 1,240 | (\$3.7) | \$8.3 | \$2.2 | (\$4.6) | (\$6.6) | (\$0.8) | \$11.2 | \$5.1 | (\$1.7) | (\$3.7) | \$2.0 | \$14.1 | \$8.0 | \$1.2 | (\$0.8) |
| Salem | 2,332 | \$14.1 | \$27.9 | \$7.2 | (\$2.6) | \$0.1 | \$16.2 | \$29.9 | \$9.2 | (\$0.6) | \$2.2 | \$18.2 | \$32.0 | \$11.3 | \$1.5 | \$4.2 |
| Surry | 1,690 | \$7.3 | \$23.7 | \$11.8 | \$2.3 | \$3.4 | \$9.4 | \$25.7 | \$13.8 | \$4.3 | \$5.5 | \$11.4 | \$27.8 | \$15.9 | \$6.4 | \$7.5 |
| Susquehanna | 2,520 | \$12.9 | \$26.5 | \$7.3 | (\$2.2) | \$0.5 | \$15.0 | \$28.6 | \$9.3 | (\$0.1) | \$2.5 | \$17.0 | \$30.6 | \$11.4 | \$1.9 | \$4.6 |
| Three Mile Island | 805 | \$3.3 | \$16.3 | (\$4.0) | (\$12.6) | (\$9.3) | \$6.1 | \$19.2 | (\$1.1) | (\$9.7) | (\$6.4) | \$9.0 | \$22.1 | \$1.8 | (\$6.8) | (\$3.5) |

Nuclear unit forward annual surplus (shortfall)

| | Surplus (Shortfall) (\$/MWh) | | | | | | | | |
|-------------------|------------------------------|----------|----------|--------------------------|----------|----------|--------------------------|----------|----------|
| | 100% of NEI Capital Costs | | | 2/3 of NEI Capital Costs | | | 1/3 of NEI Capital Costs | | |
| | 2018 | 2019 | 2020 | 2018 | 2019 | 2020 | 2018 | 2019 | 2020 |
| Beaver Valley | \$6.77 | \$3.99 | \$2.11 | \$8.82 | \$6.04 | \$4.16 | \$10.87 | \$8.09 | \$6.21 |
| Braidwood | \$0.11 | \$2.63 | \$1.93 | \$2.16 | \$4.68 | \$3.98 | \$4.21 | \$6.73 | \$6.03 |
| Byron | \$1.31 | \$2.42 | \$1.72 | \$3.36 | \$4.47 | \$3.77 | \$5.41 | \$6.52 | \$5.82 |
| Calvert Cliffs | \$10.18 | \$5.79 | \$4.14 | \$12.23 | \$7.84 | \$6.19 | \$14.28 | \$9.89 | \$8.24 |
| Cook | \$3.96 | \$3.37 | \$1.50 | \$6.01 | \$5.42 | \$3.55 | \$8.06 | \$7.47 | \$5.60 |
| Davis Besse | (\$3.73) | (\$5.57) | (\$7.44) | (\$0.84) | (\$2.68) | (\$4.55) | \$2.05 | \$0.21 | (\$1.66) |
| Dresden | \$2.78 | \$4.95 | \$4.25 | \$4.83 | \$7.00 | \$6.30 | \$6.88 | \$9.05 | \$8.35 |
| Hope Creek | \$7.35 | \$3.32 | \$2.96 | \$9.40 | \$5.37 | \$5.01 | \$11.45 | \$7.42 | \$7.06 |
| LaSalle | \$0.26 | \$2.68 | \$1.98 | \$2.31 | \$4.73 | \$4.03 | \$4.36 | \$6.78 | \$6.08 |
| Limerick | \$7.67 | \$3.74 | \$3.39 | \$9.72 | \$5.79 | \$5.44 | \$11.77 | \$7.84 | \$7.49 |
| North Anna | \$10.01 | \$5.48 | \$3.58 | \$12.06 | \$7.53 | \$5.63 | \$14.11 | \$9.58 | \$7.68 |
| Oyster Creek | (\$1.80) | (\$5.70) | (\$6.05) | \$1.09 | (\$2.81) | (\$3.16) | \$3.98 | \$0.08 | (\$0.27) |
| Quad Cities | \$0.75 | \$2.11 | \$1.40 | \$2.80 | \$4.16 | \$3.45 | \$4.85 | \$6.21 | \$5.50 |
| Peach Bottom | \$7.11 | \$3.35 | \$3.00 | \$9.16 | \$5.40 | \$5.05 | \$11.21 | \$7.45 | \$7.10 |
| Perry | (\$2.01) | (\$4.91) | (\$6.79) | \$0.88 | (\$2.02) | (\$3.90) | \$3.77 | \$0.87 | (\$1.01) |
| Salem | \$7.33 | \$3.30 | \$2.94 | \$9.38 | \$5.35 | \$4.99 | \$11.43 | \$7.40 | \$7.04 |
| Surry | \$9.74 | \$5.08 | \$3.18 | \$11.79 | \$7.13 | \$5.23 | \$13.84 | \$9.18 | \$7.28 |
| Susquehanna | \$5.83 | \$1.97 | \$0.34 | \$7.88 | \$4.02 | \$2.39 | \$9.93 | \$6.07 | \$4.44 |
| Three Mile Island | (\$4.61) | (\$8.04) | (\$9.66) | (\$1.72) | (\$5.15) | (\$6.77) | \$1.17 | (\$2.26) | (\$3.88) |

Profile of units at risk of retirement

| Technology | No. Units | ICAP (MW) | Avg. 2017 Run Hrs | Avg. Unit Age (Yrs) | Avg. Heat Rate (Btu/MWh) |
|-------------------------------------|-----------|-----------|-------------------|---------------------|--------------------------|
| CC - Combined Cycle | 5 | 590 | 497 | 33 | 11,302 |
| CT - Aero Derivative | 10 | 254 | 137 | 41 | 13,724 |
| CT - Industrial Frame | 40 | 955 | 94 | 41 | 14,434 |
| Coal Fired (high) | 46 | 21,039 | 3,346 | 46 | 10,428 |
| Coal Fired (low) (90% ACR recovery) | 38 | 17,302 | 3,304 | 46 | 10,390 |
| Diesel or Oil or Gas Steam | 12 | 889 | 968 | 36 | 11,701 |
| Nuclear (high) | 5 | 7,058 | - | 38 | - |
| Nuclear (low) (forward looking) | 3 | 2,939 | - | 38 | - |
| Total (high) | 118 | 30,785 | 1,560 | 42 | 12,312 |
| Total (low) | 108 | 22,929 | 1,404 | 42 | 12,441 |

Reserve margin: June 1, 2016 to June 1, 2020

| | Generation and DR RPM Committed Less Deficiency UCAP (MW) | Forecast Peak Load | FRR Peak Load | PRD | RPM Peak Load | IRM | Pool Wide Average EFORd | Generation and DR RPM Committed Less Deficiency ICAP (MW) | Reserve Margin | Reserve Margin in Excess of IRM Percent | Reserve Margin in Excess of IRM ICAP (MW) |
|-----------|---|-----------------------|------------------|-------|------------------|-------|-------------------------------|---|-------------------|---|---|
| 01-Jun-16 | 160,883.3 | 152,356.6 | 12,511.6 | 0.0 | 139,845.0 | 16.4% | 5.91% | 170,988.7 | 22.3% | 5.9% | 8,209.2 |
| 01-Jun-17 | 163,872.0 | 153,230.1 | 12,837.5 | 0.0 | 140,392.6 | 16.6% | 5.94% | 174,220.7 | 24.1% | 7.5% | 10,522.9 |
| 01-Jun-18 | 166,747.4 | 152,407.9 | 12,732.9 | 0.0 | 139,675.0 | 16.1% | 6.07% | 177,523.0 | 27.1% | 11.0% | 15,360.4 |
| 01-Jun-19 | 166,715.0 | 154,510.0 | 12,559.0 | 0.0 | 141,951.0 | 16.6% | 6.59% | 178,476.6 | 25.7% | 9.1% | 12,961.7 |
| 01-Jun-20 | 163,399.0 | 153,915.0 | 12,200.6 | 558.0 | 141,156.4 | 16.6% | 6.59% | 174,926.7 | 23.9% | 7.3% | 10,338.3 |



Monitoring Analytics, LLC

2621 Van Buren Avenue

Suite 160

Eagleville, PA

19403

(610) 271-8050

MA@monitoringanalytics.com

www.MonitoringAnalytics.com

