

Forward Looking EAS Offset

MIC Special Session
June 17, 2020

IMM



Monitoring Analytics

IMM Method

- **Forward energy net revenue offset for use in capacity market**
- **Forward energy prices**
 - **Western Hub forward prices from Platts**
 - **Calculated at bus level**
 - **Historical hourly price spread**
- **Forward gas prices**
 - **Pipeline forward prices from Platts**
 - **Calculated at locational level**
 - **Historical daily price spread**

IMM Method

- **Reference CT and CC unit optimally dispatched using new entrant parameters**
 - **(2019 State of the Market Report, Section 7: Net Revenue)**
- **Ancillary revenues are reactive capability payments**
 - **Average of recent FERC decisions/settlements**
 - **Currently \$3,350/MW-Year of reactive capability revenue**
 - **Unit specific data**



Issues

- **Historical time period for calculation of basis adjustment for energy and gas forwards**
- **Location(s) of CT**
 - **CONE areas**
 - **Zones**
 - **Bus**
- **Date of forwards for energy and gas**
- **Period of forwards**
 - **Delivery year**
- **Cost-based offers**



Issues

- **Apply forward looking net revenue calculation in all cases:**
 - **Net CONE in VRR curve**
 - **MOPR floors**
 - **Market seller offer caps**
 - **Unit specific reviews**
 - **Default net CONE and net ACR**
- **Actual units**
 - **Parameters**
 - **Cost-based offers**
- **IMM calculation for all units**



Results

- **Historical hourly price spreads applied to forward prices for reference CT and CC to create forward hourly prices and forward marginal costs for dispatch**
- **Three separate forward calculations for the 2021-2023 calendar years are presented using 2017 as the basis year, 2018 as the basis year, and 2019 as the basis year**
- **Gas and Western Hub forwards as of June 3, 2020**
- **E&AS historical revenues shown for reference are from 2019 State of the Market Report, Section 7: Net Revenue**

Forward E&AS: Combustion Turbine

Zone	Combustion Turbine (CT) (\$/MW-Yr)				
	3 Year Historical Avg 2017-2019	3 Year Forward Avg 2021-2023 Forwards as of June 3, 2020			Avg 2021-2023 Basis 2017-2019
		2017 Basis	2018 Basis	2019 Basis	
AECO	\$32,574	\$25,451	\$32,554	\$25,045	\$27,684
AEP	\$54,690	\$41,478	\$48,183	\$46,147	\$45,269
APS	\$51,768	\$59,879	\$65,408	\$58,456	\$61,248
ATSI	\$60,382	\$52,657	\$65,702	\$53,368	\$57,242
BGE	\$45,211	\$46,038	\$50,557	\$46,625	\$47,740
ComEd	\$29,428	\$34,690	\$28,049	\$34,719	\$32,486
DAY	\$59,999	\$51,166	\$60,727	\$59,828	\$57,240
DEOK	\$60,407	\$47,292	\$60,704	\$53,702	\$53,900
DLCO	\$48,243	\$32,586	\$48,591	\$32,742	\$37,973
Dominion	\$46,875	\$45,910	\$52,625	\$46,030	\$48,188
DPL	\$24,245	\$24,040	\$35,552	\$27,188	\$28,927
EKPC	\$44,149	\$56,290	\$69,020	\$47,547	\$57,619
JCPL	\$32,771	\$27,924	\$29,983	\$23,963	\$27,290
Met-Ed	\$46,651	\$41,592	\$40,495	\$36,186	\$39,424
PECO	\$39,180	\$35,251	\$36,790	\$29,896	\$33,979
PENELEC	\$66,285	\$56,917	\$64,162	\$51,180	\$57,420
Pepco	\$33,018	\$40,418	\$45,411	\$40,723	\$42,184
PPL	\$59,766	\$49,302	\$50,351	\$42,650	\$47,434
PSEG	\$44,637	\$34,817	\$35,520	\$28,084	\$32,807
RECO	\$34,918	\$30,262	\$34,721	\$27,763	\$30,915
PJM	\$45,760	\$41,698	\$47,755	\$40,592	\$43,349



Forward E&AS: Combustion Turbine, 2017 Basis

Zone	3 Year Historical Avg 2017-2019	Forwards as of June 3, 2020 2017 Basis Year			3 Year Forward Avg 2021-2023
		2021	2022	2023	
AECO	\$32,574	\$22,439	\$25,647	\$28,268	\$25,451
AEP	\$54,690	\$38,213	\$40,982	\$45,238	\$41,478
APS	\$51,768	\$56,945	\$59,678	\$63,014	\$59,879
ATSI	\$60,382	\$49,700	\$53,609	\$54,663	\$52,657
BGE	\$45,211	\$42,145	\$46,118	\$49,851	\$46,038
ComEd	\$29,428	\$32,591	\$35,374	\$36,106	\$34,690
DAY	\$59,999	\$48,156	\$52,116	\$53,225	\$51,166
DEOK	\$60,407	\$44,601	\$48,204	\$49,072	\$47,292
DLCO	\$48,243	\$30,402	\$32,190	\$35,167	\$32,586
DOM	\$46,875	\$41,520	\$46,014	\$50,196	\$45,910
DPL	\$24,245	\$23,270	\$24,197	\$24,653	\$24,040
EKPC	\$44,149	\$53,161	\$55,918	\$59,791	\$56,290
JCPL	\$32,771	\$24,891	\$28,133	\$30,748	\$27,924
MetEd	\$46,651	\$38,298	\$41,112	\$45,367	\$41,592
PECO	\$39,180	\$31,846	\$34,906	\$39,001	\$35,251
PENELEC	\$66,285	\$54,135	\$56,699	\$59,918	\$56,917
Pepco	\$33,018	\$36,719	\$40,432	\$44,102	\$40,418
PPL	\$59,766	\$46,629	\$49,203	\$52,074	\$49,302
PSEG	\$44,637	\$32,013	\$34,483	\$37,956	\$34,817
RECO	\$34,918	\$27,133	\$30,397	\$33,255	\$30,262
PJM	\$45,760	\$38,740	\$41,771	\$44,583	\$41,698

Forward E&AS: Combustion Turbine, 2018 Basis

Zone	3 Year Historical Avg 2017-2019	Forwards as of June 3, 2020 2018 Basis Year			3 Year Forward Avg 2021-2023
		2021	2022	2023	
AECO	\$32,574	\$30,670	\$32,561	\$34,431	\$32,554
AEP	\$54,690	\$45,086	\$47,765	\$51,699	\$48,183
APS	\$51,768	\$63,217	\$65,356	\$67,652	\$65,408
ATSI	\$60,382	\$63,562	\$66,351	\$67,192	\$65,702
BGE	\$45,211	\$46,966	\$50,577	\$54,127	\$50,557
ComEd	\$29,428	\$26,681	\$28,512	\$28,953	\$28,049
DAY	\$59,999	\$58,417	\$61,406	\$62,358	\$60,727
DEOK	\$60,407	\$58,623	\$61,308	\$62,182	\$60,704
DLCO	\$48,243	\$46,776	\$48,017	\$50,979	\$48,591
DOM	\$46,875	\$48,684	\$52,528	\$56,663	\$52,625
DPL	\$24,245	\$35,113	\$35,315	\$36,227	\$35,552
EKPC	\$44,149	\$67,525	\$68,925	\$70,611	\$69,020
JCPL	\$32,771	\$28,119	\$29,889	\$31,940	\$29,983
MetEd	\$46,651	\$38,224	\$40,199	\$43,062	\$40,495
PECO	\$39,180	\$34,822	\$36,604	\$38,943	\$36,790
PENELEC	\$66,285	\$62,221	\$64,141	\$66,126	\$64,162
Pepco	\$33,018	\$41,964	\$45,342	\$48,927	\$45,411
PPL	\$59,766	\$49,760	\$50,420	\$50,874	\$50,351
PSEG	\$44,637	\$34,129	\$35,394	\$37,039	\$35,520
RECO	\$34,918	\$32,874	\$34,816	\$36,475	\$34,721
PJM	\$45,760	\$45,672	\$47,771	\$49,823	\$47,755

Forward E&AS: Combustion Turbine, 2019 Basis

Zone	3 Year Historical Avg 2017-2019	Forwards as of June 3, 2020 2019 Basis Year			3 Year Forward Avg 2021-2023
		2021	2022	2023	
AECO	\$32,574	\$22,802	\$25,157	\$27,177	\$25,045
AEP	\$54,690	\$42,810	\$45,781	\$49,850	\$46,147
APS	\$51,768	\$55,862	\$58,294	\$61,213	\$58,456
ATSI	\$60,382	\$50,692	\$54,206	\$55,206	\$53,368
BGE	\$45,211	\$43,510	\$46,681	\$49,685	\$46,625
ComEd	\$29,428	\$32,789	\$35,411	\$35,959	\$34,719
DAY	\$59,999	\$56,996	\$60,698	\$61,791	\$59,828
DEOK	\$60,407	\$51,062	\$54,542	\$55,502	\$53,702
DLCO	\$48,243	\$30,864	\$32,347	\$35,014	\$32,742
DOM	\$46,875	\$42,077	\$46,063	\$49,949	\$46,030
DPL	\$24,245	\$27,540	\$26,733	\$27,290	\$27,188
EKPC	\$44,149	\$46,047	\$46,676	\$49,918	\$47,547
JCPL	\$32,771	\$21,686	\$24,108	\$26,096	\$23,963
MetEd	\$46,651	\$33,424	\$35,692	\$39,443	\$36,186
PECO	\$39,180	\$27,237	\$29,603	\$32,848	\$29,896
PENELEC	\$66,285	\$48,612	\$51,062	\$53,868	\$51,180
Pepco	\$33,018	\$37,502	\$40,766	\$43,902	\$40,723
PPL	\$59,766	\$40,848	\$42,497	\$44,606	\$42,650
PSEG	\$44,637	\$25,755	\$27,923	\$30,575	\$28,084
RECO	\$34,918	\$24,827	\$27,921	\$30,540	\$27,763
PJM	\$45,760	\$38,147	\$40,608	\$43,022	\$40,592



Forward E&AS: Combined Cycle

Zone	Combined Cycle (CC) (\$/MW-Yr)				
	3 Year Historical Avg 2017-2019	3 Year Forward Avg 2021-2023 Forwards as of June 3, 2020			Avg 2021-2023 Basis 2017-2019
		2017 Basis	2018 Basis	2019 Basis	
AECO	\$59,904	\$45,369	\$51,949	\$42,524	\$46,614
AEP	\$84,738	\$76,387	\$80,618	\$80,766	\$79,257
APS	\$89,471	\$97,446	\$99,970	\$97,414	\$98,277
ATSI	\$89,403	\$92,244	\$99,719	\$92,443	\$94,802
BGE	\$84,981	\$71,116	\$74,830	\$69,978	\$71,975
ComEd	\$50,012	\$67,912	\$54,507	\$67,380	\$63,266
DAY	\$90,200	\$91,824	\$95,833	\$100,418	\$96,025
DEOK	\$89,119	\$85,656	\$92,662	\$92,635	\$90,318
DLCO	\$74,768	\$63,327	\$76,321	\$64,750	\$68,133
Dominion	\$77,141	\$77,967	\$83,414	\$77,392	\$79,591
DPL	\$35,737	\$39,185	\$52,147	\$35,144	\$42,158
EKPC	\$73,889	\$88,149	\$97,429	\$74,859	\$86,812
JCPL	\$60,229	\$47,959	\$48,056	\$42,287	\$46,101
Met-Ed	\$72,925	\$71,531	\$68,404	\$69,819	\$69,918
PECO	\$66,078	\$65,971	\$65,323	\$60,895	\$64,063
PENELEC	\$92,641	\$92,919	\$97,000	\$89,355	\$93,091
Pepco	\$69,227	\$65,593	\$69,323	\$64,292	\$66,403
PPL	\$82,473	\$81,667	\$77,529	\$76,117	\$78,438
PSEG	\$72,645	\$58,428	\$56,051	\$51,161	\$55,214
RECO	\$62,231	\$51,487	\$52,988	\$49,744	\$51,407
PJM	\$73,891	\$71,607	\$74,704	\$69,969	\$72,093



Forward E&AS: Combined Cycle, 2017 Basis

Zone	3 Year Historical Avg 2017-2019	Forwards as of June 3, 2020 2017 Basis Year			3 Year Forward Avg 2021-2023
		2021	2022	2023	
AECO	\$59,904	\$41,255	\$45,621	\$49,230	\$45,369
AEP	\$84,738	\$72,462	\$75,843	\$80,857	\$76,387
APS	\$89,471	\$95,720	\$97,070	\$99,548	\$97,446
ATSI	\$89,403	\$90,134	\$92,765	\$93,834	\$92,244
BGE	\$84,981	\$66,633	\$71,338	\$75,377	\$71,116
ComEd	\$50,012	\$66,031	\$68,324	\$69,380	\$67,912
DAY	\$90,200	\$89,705	\$92,351	\$93,417	\$91,824
DEOK	\$89,119	\$83,499	\$86,188	\$87,281	\$85,656
DLCO	\$74,768	\$59,561	\$62,811	\$67,610	\$63,327
DOM	\$77,141	\$73,033	\$78,351	\$82,517	\$77,967
DPL	\$35,737	\$37,415	\$39,123	\$41,016	\$39,185
EKPC	\$73,889	\$84,471	\$87,695	\$92,280	\$88,149
JCPL	\$60,229	\$43,826	\$48,184	\$51,868	\$47,959
MetEd	\$72,925	\$67,307	\$71,100	\$76,184	\$71,531
PECO	\$66,078	\$61,503	\$65,687	\$70,722	\$65,971
PENELEC	\$92,641	\$91,209	\$92,528	\$95,020	\$92,919
Pepco	\$69,227	\$61,189	\$65,828	\$69,764	\$65,593
PPL	\$82,473	\$79,604	\$81,341	\$84,057	\$81,667
PSEG	\$72,645	\$54,647	\$57,976	\$62,663	\$58,428
RECO	\$62,231	\$47,111	\$51,714	\$55,636	\$51,487
PJM	\$73,891	\$68,316	\$71,592	\$74,913	\$71,607



Forward E&AS: Combined Cycle, 2018 Basis

Zone	3 Year Historical Avg 2017-2019	Forwards as of June 3, 2020 2018 Basis Year			3 Year Forward Avg 2021-2023
		2021	2022	2023	
AECO	\$59,904	\$49,747	\$52,041	\$54,060	\$51,949
AEP	\$84,738	\$76,763	\$80,222	\$84,870	\$80,618
APS	\$89,471	\$98,348	\$99,712	\$101,850	\$99,970
ATSI	\$89,403	\$97,833	\$100,048	\$101,275	\$99,719
BGE	\$84,981	\$71,019	\$75,067	\$78,405	\$74,830
ComEd	\$50,012	\$52,726	\$54,971	\$55,825	\$54,507
DAY	\$90,200	\$93,786	\$96,185	\$97,529	\$95,833
DEOK	\$89,119	\$90,661	\$92,976	\$94,349	\$92,662
DLCO	\$74,768	\$73,499	\$75,598	\$79,866	\$76,321
DOM	\$77,141	\$79,010	\$83,744	\$87,487	\$83,414
DPL	\$35,737	\$52,006	\$51,872	\$52,561	\$52,147
EKPC	\$73,889	\$95,457	\$97,064	\$99,767	\$97,429
JCPL	\$60,229	\$45,722	\$48,167	\$50,278	\$48,056
MetEd	\$72,925	\$65,656	\$68,229	\$71,327	\$68,404
PECO	\$66,078	\$62,476	\$65,188	\$68,304	\$65,323
PENELEC	\$92,641	\$95,442	\$96,772	\$98,786	\$97,000
Pepco	\$69,227	\$65,625	\$69,437	\$72,908	\$69,323
PPL	\$82,473	\$77,127	\$77,427	\$78,032	\$77,529
PSEG	\$72,645	\$54,403	\$55,856	\$57,894	\$56,051
RECO	\$62,231	\$50,613	\$53,164	\$55,188	\$52,988
PJM	\$73,891	\$72,396	\$74,687	\$77,028	\$74,704



Forward E&AS: Combined Cycle, 2019 Basis

Zone	3 Year Historical Avg 2017-2019	Forwards as of June 3, 2020 2019 Basis Year			3 Year Forward Avg 2021-2023
		2021	2022	2023	
AECO	\$59,904	\$38,809	\$42,780	\$45,983	\$42,524
AEP	\$84,738	\$76,722	\$80,488	\$85,088	\$80,766
APS	\$89,471	\$95,742	\$97,108	\$99,393	\$97,414
ATSI	\$89,403	\$90,466	\$92,943	\$93,922	\$92,443
BGE	\$84,981	\$65,918	\$70,024	\$73,992	\$69,978
ComEd	\$50,012	\$65,739	\$67,817	\$68,583	\$67,380
DAY	\$90,200	\$98,508	\$100,881	\$101,866	\$100,418
DEOK	\$89,119	\$90,687	\$93,109	\$94,110	\$92,635
DLCO	\$74,768	\$61,114	\$64,424	\$68,711	\$64,750
DOM	\$77,141	\$72,485	\$77,693	\$81,998	\$77,392
DPL	\$35,737	\$34,989	\$34,603	\$35,839	\$35,144
EKPC	\$73,889	\$72,082	\$74,138	\$78,355	\$74,859
JCPL	\$60,229	\$38,477	\$42,503	\$45,882	\$42,287
MetEd	\$72,925	\$65,499	\$69,632	\$74,325	\$69,819
PECO	\$66,078	\$56,410	\$60,812	\$65,463	\$60,895
PENELEC	\$92,641	\$87,492	\$89,178	\$91,394	\$89,355
Pepco	\$69,227	\$60,177	\$64,376	\$68,321	\$64,292
PPL	\$82,473	\$74,300	\$75,911	\$78,140	\$76,117
PSEG	\$72,645	\$47,321	\$51,013	\$55,150	\$51,161
RECO	\$62,231	\$45,320	\$50,050	\$53,862	\$49,744
PJM	\$73,891	\$66,913	\$69,974	\$73,019	\$69,969



Forward E&AS: CT & CC

	\$/MW-Day	
	CT	CC
Gross CONE (ICAP)	\$294	\$320
E&AS Revenues (historical)	\$125	\$202
Net CONE (ICAP) (historical)	\$169	\$118
E&AS Revenues (forward)	\$119	\$198
Net CONE (ICAP) (forward)	\$175	\$122



Forward E&AS: CT & CC

- **E&AS forward revenues are the average results of three separate forward calculations for the 2021-2023 calendar years using 2017 as the basis year, 2018 as the basis year, and 2019 as the basis year**
- **For the CT, \$43,349/MW-Yr = \$119/MW-Day**
- **For the CC, \$72,093/MW-Yr = \$198/MW-Day**



Pipeline Mapping

Zone	Pipeline
AECO	Transco Zn6 non-NY
AEP	Texas Gas Zn 1
APS	Dominion S Pt
ATSI	Mich Con CG
BGE	Transco Zn6 non-NY
COMED	Chicago CG
DAY	Mich Con CG
DEOK	Mich Con CG
DLCO	TX Eastern M-3
DOM	Transco Zn5 Dlv
DPL	Transco Zn6 non-NY
EKPC	Tenn LA 500 Leg
JCPL	Transco Zn6 non-NY
METED	TX Eastern M-3
PECO	TX Eastern M-3
PENELEC	Dominion S Pt
PEPCO	Transco Zn5 Dlv
PPL	Tennessee zone 4-300 leg
PSEG	TX Eastern M-3
RECO	Transco Zn6 NY



Net Revenue Calculation: LMP

- **Forward LMPs for a specific generator**
 - **PJM Western Hub future prices**
 - **multiplied by a monthly locational basis factor and**
 - **an hourly basis factor.**
- **Separate calculations for on peak and off peak hours.**
- **The locational basis factor and hourly basis factor are calculated using the generator's historical real time LMP.**

Net Revenue Calculation: LMP

- **On peak locational basis factor**
- **The monthly average of the ratio of the hourly bus LMP to the hourly Western Hub LMP for on peak hours.**
- **Off peak locational basis factor**
- **The monthly average of the ratio of the hourly bus LMP to the hourly Western Hub LMP for off peak hours.**



Net Revenue Calculation: LMP

- On peak hourly basis factor.
- The hourly basis factor is the ratio of the historical bus LMP to the average historical bus LMP for on peak hours during the month.
- Off peak hourly basis factor.
- The hourly basis factor is the ratio of the historical bus LMP to the average historical bus LMP for off peak hours during the month.



Net Revenue Calculation: Fuel Costs

- **Forward fuel price for a specific generator**
 - Forward prices for specific pipeline
 - Plus basis adjustment as required
 - Multiplied by a daily basis factor.
- **The daily basis factor is the ratio of the historical daily delivered fuel price to the average monthly historical delivered fuel price.**

Net Revenue: Cost

- **The hourly operating cost (\$/MWh) is the short run marginal cost of generating energy.**
- **The forward delivered fuel price**
- **Heat rate**
- **Emission rate**
- **VOM cost.**



Net Revenue: CT Optimal Dispatch

- The CT plant is a single GE Frame 7HA.02 CT with an installed capacity of 360.1 MW, equipped with evaporative coolers, and selective catalytic reduction (SCR) for NOx reduction.
- The CT unit was dispatched in profitable blocks of at least two hours, including start costs.



Net Revenue: CC Optimal Dispatch

- The CC plant includes two GE Frame 7HA.02 CTs and a single steam turbine generator with an installed capacity of 1,137.2 MW, equipped with evaporative cooling, duct burners, a heat recovery steam generator (HRSG) for each CT, with steam reheat, and SCR for NOx reduction.
- The CC unit was dispatched in profitable blocks of at least four hours, including start costs.

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