



Monitoring
Analytics

CONE and ACR Values - Preliminary

The Independent Market Monitor for PJM

January 21, 2020

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Introduction

The IMM has calculated preliminary gross cost of new entry (CONE), gross avoidable cost rate (ACR), net CONE and net ACR values for the basic technologies at issue in the Commission's December 19, 2019, MOPR Order in order to provide a factual basis for discussions of the order and its potential impacts.¹ The preliminary gross CONE and gross ACR values and the net energy and ancillary services revenues (net E&AS or net revenues) are not expected to change significantly when final. The IMM used the same approach to the calculations of gross CONE that the IMM has used in the State of the Market Report and in the Triennial and Quadrennial Review processes.²

The results in Table 1 show that net ACR values, including major maintenance, for new entry from all technologies are zero, with the exception of coal and diesel for which net ACR values are less than \$36 per MW-day and nuclear for which net ACR is \$69.67 per MW-day for a two unit plant and \$379.99 for a single unit plant. Based on the recent FERC order about inclusion of maintenance expense in energy offers, major maintenance costs can no longer be included in gross ACR values.³ The results in Table 1 show that net ACR values, excluding major maintenance, for new entry from all technologies are zero, with the exception of diesel for which net ACR is less than \$25 per MW-day and single unit nuclear for which net ACR is \$179.99 per MW-day.

The results in Table 1 show that net CONE values are relatively low for combined cycle (CC) plants and high for coal and nuclear plants. Net CONE values for onshore and offshore wind, and for solar, are high enough that offers based on these values would be unlikely to clear in a capacity auction, based on the clearing prices in recent capacity auctions. Capacity market prices in the last two base residual auctions (BRAs) ranged from \$76.53 to \$204.29.⁴ Net CONE values for these resources also exceed the net CONE times B offer cap for the 2021/2022 BRA, which ranged from \$158.43 per MW-day to \$254.40 per MW-day.

The values in Table 1 are based on identified values for the technology and financial costs, accounting for current depreciation rules and the tax code. Unit specific results may vary significantly. For example, the net revenue offset for a combined cycle plant varies significantly by location. For example, the net revenue offset for wind and solar

¹ *PJM Interconnection, L.L.C. et al.*, 169 FERC ¶ 61,239.

² See the 2018 *State of the Market Report for PJM*, Section 7: "Net Revenue."

³ 167 FERC ¶ 61,030.

⁴ In the 2020/2021 BRA, rest of RTO cleared at \$76.53 per MW-day. In the 2021/2022 BRA, PSEG LDA cleared at \$204.29 per MW-day.

plants depends heavily on the achieved capacity factor which can vary significantly by site. The net revenue for nuclear plants also varies significantly by location.

Table 1 New entrant gross CONE, gross ACR, net CONE and net ACR for selected technologies^{5 6 7 8 9 10}

	\$/MW-Day														
	CT	CC	Coal	Nuclear	Diesel	Onshore Wind				Offshore		Solar			
						AEP	APS	ComEd	PENELEC	Wind	AECO	Dominion	DPL	JCPL	PSEG
Levelized Gross CONE w/ major maintenance	\$338.18	\$319.53	\$1,553.07	\$3,338.27	\$465.37	\$619.32	\$602.56	\$636.02	\$587.50	\$1,998.04	\$712.94	\$580.79	\$582.82	\$712.94	\$712.94
Gross ACR (new entrant) w/ major maintenance	\$75.94	\$33.80	\$78.37	\$1,008.00 single \$697.68 multi	\$55.96	\$94.63	\$94.67	\$94.82	\$94.74	\$233.98	\$14.20	\$14.20	\$14.20	\$14.20	\$14.20
Gross ACR (new entrant) w/o major maintenance	\$11.16	\$15.28	\$66.89	\$807.80 single \$562.80 multi	\$45.44	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
New entrant E&AS	\$77.79	\$171.08	\$68.07	\$628.01	\$20.88	\$192.97	\$160.62	\$163.93	\$152.34	\$256.21	\$89.41	\$162.94	\$122.43	\$82.71	\$93.28
2019 Preliminary E&AS	AECO	AECO	DOM	PJM Average	PJM Average	AEP	APS	ComEd	PENELEC	AECO	AECO	DOM	DPL	JCPL	PSEG
Net CONE	\$260.39	\$148.45	\$1,485.00	\$2,710.25	\$444.49	\$426.35	\$441.94	\$472.09	\$435.17	\$1,741.83	\$623.53	\$417.85	\$460.39	\$630.23	\$619.66
Net ACR w/ major maintenance	\$0.00	\$0.00	\$10.30	\$379.99 single \$69.67 multi	\$35.08	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Net ACR w/o major maintenance	\$0.00	\$0.00	\$0.00	\$179.79 single \$0.00 multi	\$24.56	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00

The results in Table 2 show that net ACR values, including major maintenance, for existing CC, wind and solar technologies are zero and, for all other existing technologies except single unit nuclear, are less than \$70 per MW-day. Net ACR is \$69.67 per MW-day for a two unit nuclear plant and \$379.99 for a single unit nuclear plant. The net

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- 5 Nuclear ACR values with major maintenance in \$ per MW-day are total generating costs in MWh from Nuclear Energy Institute multiplied by 24. See Nuclear Energy Institute (September, 2019) "Nuclear Costs in Context," <<https://www.nei.org/resources/reports-briefs/nuclear-costs-in-context>>. The NEI data on nuclear ACR costs do not permit the separate identification of maintenance costs. The nuclear ACR values without major maintenance exclude annual nuclear capital expenditures that are included explicitly in the NEI data.
 - 6 E&AS for the CT, CC and coal plant are preliminary zonal energy net revenues plus associated ancillary revenue. The E&AS calculations are explained in the 2018 *State of the Market Report for PJM*, Section 7: "Net Revenue."
 - 7 E&AS for the nuclear plant are preliminary PJM average zonal gross energy revenues plus associated ancillary revenue. Nuclear fuel costs are included in the NEI cost data.
 - 8 E&AS for the diesel plant are preliminary PJM average energy net revenues plus associated ancillary revenue.
 - 9 E&AS for onshore wind and solar are preliminary gross energy revenues and assume that the new entrant unit operates at the average capacity factor of all units of that type in the specified zone with an installed capacity greater than 3 MW. Short run marginal costs for wind and solar are assumed to be zero.
 - 10 E&AS for offshore wind assumes the unit receives zonal energy prices and operates at a capacity factor of 45 percent. The short run marginal cost for offshore wind is assumed to be zero.

revenues in Table 2 are net revenues for new units by technology. Actual net revenues for existing units will be calculated on a unit specific basis. Based on the recent FERC order about inclusion of maintenance expense in energy offers, major maintenance costs can no longer be included in gross ACR values. The results in Table 2 show that net ACR values, excluding major maintenance, for all existing technologies are zero, with the exception of coal and diesel which are less than \$37 per MW-day and single unit nuclear which is \$179.79 per MW-day for a one unit plant. Based on the net ACR values and the clearing prices in recent capacity auctions, all existing technologies except single unit nuclear plants would be expected to clear if subject to a net ACR MOPR price floor. Capacity market prices in the last two base residual auctions (BRAs) ranged from \$76.53 to \$204.29.¹¹

The net revenues for existing nuclear plants are a function of location and whether historical or forward looking net revenues are used. The net revenues in Table 2 are based on PJM zonal average LMPs in 2019. While the results in Table 2 are generally consistent with the unit specific results reported in the State of the Market Reports, the results for individual units may vary. The historical results through 2018 and the forward looking results are included in the 2018 State of the Market Report.¹²

Table 2 Existing unit gross ACR and net ACR for selected technologies

	\$/MW-Day														
	CT	CC	Coal	Nuclear	Diesel	Onshore Wind				Offshore		Solar			
						AEP	APS	ComEd	PENELEC	Wind	AECO	Dominion	DPL	JCPL	PSEG
Gross ACR (existing unit) w/ major maintenance	\$114.02	\$48.74	\$118.93	\$1,008.00 single \$697.68 multi	\$55.96	\$94.63	\$94.67	\$94.82	\$94.74	\$233.98	\$14.20	\$14.20	\$14.20	\$14.20	\$14.20
Gross ACR (existing unit) w/o major maintenance	\$22.07	\$24.82	\$104.69	\$807.80 single \$562.80 multi	\$45.44	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
New entrant E&AS	\$77.79	\$171.08	\$68.07	\$628.01	\$20.88	\$192.97	\$160.62	\$163.93	\$152.34	\$256.21	\$89.41	\$162.94	\$122.43	\$82.71	\$93.28
2019 Preliminary E&AS	AECO	AECO	DOM	PJM Average	PJM Average	AEP	APS	ComEd	PENELEC	AECO	AECO	DOM	DPL	JCPL	PSEG
Net ACR w/ major maintenance	\$36.23	\$0.00	\$50.86	\$379.99 single \$69.67 multi	\$35.08	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Net ACR w/o major maintenance	\$0.00	\$0.00	\$36.62	\$179.79 single \$0.00 multi	\$24.56	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00

Basis for Calculations

The CT plant has an installed capacity of 360.1 MW and consists of one GE Frame 7HA.02 CT, equipped with evaporative coolers and selective catalytic reduction (SCR) for NOx reduction.

The CC plant has an installed capacity of 1,137.2 MW and consists of two GE Frame 7HA.02 CTs equipped with evaporative cooling, duct burners, a heat recovery steam

¹¹ In the 2020/2021 BRA, rest of RTO cleared at \$76.53 per MW-day. In the 2021/2022 BRA, PSEG LDA cleared at \$204.29 per MW-day.

¹² The E&AS calculations are presented and explained in the 2018 State of the Market Report for PJM, Section 7: "Net Revenue."

generator (HRSG) for each CT with steam reheat and SCR for NO_x reduction with a single steam turbine generator.

The coal plant (CP) has an installed capacity of 600.0 MW and is a sub-critical steam unit, equipped with selective catalytic reduction system (SCR) for NO_x control, a flue gas desulphurization (FGD) system with chemical injection for SO_x and mercury control, and a bag-house for particulate control.

The diesel plant has an installed capacity of 2.0 MW and consists of one oil fired CAT 2 MW Tier 4 unit using New York Harbor ultra low sulfur diesel.

The nuclear plant has an installed capacity of 2,200.0 MW and consists of two reactors and related facilities using the Westinghouse AP1000 technology.

The onshore wind installation consists of 37 Siemens 2.7 MW wind turbines totaling 99.9 MW installed capacity. Turbine placement was set at 105 acres per turbine to minimize turbine interference which resulted in land requirements of 4,000 acres for the 100 MW facility.

The offshore wind installation consists of 43 Siemens 7.0 MW wind turbines totaling 301.0 MW installed capacity. The wind power facility design is based on the Siemens SWT-7.0-154 wind turbine with a 7.0 MW capacity and diameter of 154 meters. Turbine placement was set on 72,000 acres, 60,000 acres for the turbines and 12,000 for corridors which results in 1,674 acres per turbine.

The solar installation consists of a ground mounted solar farm totaling 10 MW of AC installed capacity on 35.5 acres. To obtain the CONE solar power facility AC capacity of 10.0 MW, 13.49 MW of DC capacity would be installed. To achieve the 13.49 MW of DC capacity requires the installation of 35,500 - 380 watt rated solar panels. The 10 MW AC ground mounted solar power facility would be expected to produce 18,576 MWh of AC electricity annually. For these locations and the efficiency of the panels the conversion is 1,377 AC MWh annual production per MW DC installed capacity.

Proforma Analysis

A 20 year after tax discounted cash flow (ATDCF) model was used to determine the levelized revenue requirements for the power plant to recover capital cost, annual fixed operations and maintenance (O&M) expenses and earn the target after tax internal rate of return (IRR) for the investor/owner.¹³ The mid-year convention was used to account

¹³ A 30 year after tax discounted cash flow (ATDCF) model was used to determine the levelized revenue requirements for the new entrant nuclear plant. If there were a new nuclear plant subject to MOPR it would be evaluated on a 20 year life.

for revenues and expenses incurred continuously throughout each year in the 20 year project life evaluation.

Table 3 Financial criteria¹⁴

Target IRR	12.0%
Debt to equity ratio	50/50
Debt term	20 years
Debt interest rate	7.0%
Tax depreciation	First year 100% bonus depreciation
Escalation rate	2.5%
Federal income tax rate	21.0%
State tax rate	
IL	7.0%
IN	6.0%
MD	8.25%
NJ	9.0%
PA	9.9%
VA	6.0%
WV	6.5%

The values are presented in mid-year July 1, 2019, dollars. Revenue requirements are expressed in \$ per MW-year and \$ per MW-day and are nominal levelized.

¹⁴ The new federal tax code allows for the 2019 CONE power plants to use first year 100 percent bonus depreciation in lieu of the previous Modified Accelerated Cost Recovery System (MACRS) depreciation over a 15 year tax life for a CT and 20 year tax life for a CC and coal plant for the qualifying portions of the total project cost. The new federal tax code for renewable energy projects allows first year bonus depreciation on 85 percent of the qualifying portions of the total project capital cost in lieu of the previous Modified Accelerated Cost Recovery System (MACRS) depreciation over a five year period on 85 percent of the qualifying portions of the total project capital cost. Also the solar and wind power facilities receive a federal 1603 investment tax credit (ITC) of 30 percent of the total project capital cost.