Preliminary
Default MOPR Floor Offer Prices for New Generation Capacity Resources

Market Implementation Committee

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Default MOPR Floor Price for New Resources

- Based on Net Cost of New Entry ("CONE") for relevant technology type
- Net CONE = Gross CONE – Net E&AS revenue
  - Gross CONE: levelized annual cost to construct a new resource plus annual fixed operation and maintenance costs
  - Net E&AS: expected energy and ancillary service market revenues
- PJM and the IMM continue to work together to refine estimates of Gross CONE and Net E&AS with the intent of developing a single set of technology specific default MOPR floor prices

Preliminary Gross CONE Values

- PJM has developed preliminary Gross CONE values for the following generation technology types:
  - CT, CC, Coal, Nuclear, Solar, Onshore Wind, Offshore Wind and Battery Storage
- Based on published installed capital costs and annual fixed O&M costs
  - New entry CT and CC from the 2018 Quadrennial Review
  - All other technology types from 2020 EIA capital cost report
- EIA capital cost report
  - Provides current and well documented cost estimates
  - Consistent with other publicly available data sources (EPA, Lazard, NREL)

Appendix provides links and a comparison of capital costs from the various data sources

Table 1 – Total Capital Cost and Fixed O&M Cost

Resource Type	Technology Description	Source of Information	Fixed O&M ($/kW-year)	Installed Capital Cost ($/kW)
Nuclear	2 x Westinghouse AP1000 Pressurized Water Reactor (2,156 MW)	EIA (Case 11)	122	6,041
Coal	Ultra-Super Critical Coal (650 MW)	EIA (Case 1)	41	3,676
Combined Cycle	2x1 GE Frame 7HA with evaporative cooling and SCR (1,152 MW)	Quadrennial Review	24	874
Combustion Turbine	GE Frame 7HA CT with evaporative cooling, SCR, dual fuel (352 MW)	Quadrennial Review	17	875
Solar PV	Single-axis tracking (150 MW AC)	EIA (Case 24)	15	1,313
Onshore Wind	17 x 2.8 MW WTGs (50 MW)	EIA (Case 21)	35	1,677
Offshore Wind	40 x 10 WTGs, 30 miles off, 100 ft depth (400 MW)	EIA (Case 22)	110	4,375
Battery Storage	50 MW utility scale, Li, 200 MWh rating (50 MW/200 MWh)	EIA (Case 18)	25	1,389

Preliminary Gross CONE Values (Cont.)

Financial assumptions developed during 2018 Quadrennial Review used to determine Gross CONE from the installed capacity costs and fixed costs

Financial Assumptions	
Expected Life	20 Years
Debt Ratio	55.0%
Debt Rate	6.0%
Equity Rate	13.0%
Total Tax Rate	27.7%
ATWACC	8.2%

Gross CONE reflects 100% bonus depreciation and 30% Investment Tax Credit for solar and wind

Table 2 – Preliminary Gross CONE Values

Resource Type	Fixed O&M ($/kW-year)	Installed Capital Cost ($/kW)	Gross CONE ($/ICAP MW-Day)
Nuclear	122	6,041	2,064
Coal	41	3,676	1,149
Combined Cycle	24	874	320
Combustion Turbine	17	875	294
Solar PV	15	1,313	290
Onshore Wind	35	1,677	420
Offshore Wind	110	4,375	1,155
Battery Storage	25	1,389	464

Net E&AS Offset Revenues

- FERC order requires that net E&AS offset revenues be determined for each transmission zone
- A proposed method for estimating the net energy market revenues for each technology type is described in Tables A-1 and A-2 of the Appendix
- Proposed method would use historical zonal LMPs from three most recent calendar years to develop zonal Net E&AS values
- Until these values are calculated, for informational purposes only, Table 3 provides preliminary Net CONE values determined using the Gross CONE values of Table 2 and Net E&AS values used in PJM's 10/2/2018 filing

Table 3 – Informational Net CONE Values

Resource Type	Gross CONE ($/ICAP MW-Day)	EAS Revenue Offset* ($/ICAP MW-Day)	Net CONE* ($/ICAP MW-Day)
Nuclear	2,064	366	1,698
Coal	1,149	45	1,104
Combined Cycle	320	85	235
Combustion Turbine	294	26	268
Solar PV**	290	101	449
Onshore Wind**	420	173	1,681
Offshore Wind**	1,155	307	3,261
Battery Storage	464	N/A	N/A

* Placeholder value using EAS Revenue Offset from October 2018 filing.

** Net CONE values for Solar PV, Onshore Wind and Offshore Wind reflect capacity value based on 42%, 14.7% and 26%, respectively of the nameplate rating of these resource types and are expressed in $/UCAP MW-day

Next Steps

- Stakeholder feedback on assumptions and approach
- Continue coordinated refinement with IMM of estimates of costs and revenues

Appendix

Table A1 - Description of Method for Estimating Net Energy Market Revenue

Resource Type	Method for Estimating Net Energy Market Revenue
Nuclear	Gross revenue determined by average annual LMP multiplied by annual energy output at assumed 98% capacity factor. Net revenue determined by gross revenue minus cost to generate annual energy output (i.e., fuel cost, Var O&M cost, MM costs not included in Fixed O&M)
Coal	TBD
Combined Cycle	Simulated dispatch with commitment for entire 16-hour period between HE 8 and HE 23 of each day if average LMP exceeds cost to generate (+10%) over this period. HR = 6,553 Btu/kWh and Var O&M = $2.11/MWh
Combustion Turbine	Simulated dispatch with commitment for each 4-hour blocks between HE 8 and HE 23 of each day if LMPs exceed cost to generate (+10%) in 2 of the 4 hours of each block. HR = 9,134 Btu/kWh and Var. O&M=$6.93/MWh

Table A2 - Description of Method for Estimating Net Energy Market Revenue

Resource Type	Method for Estimating Net Energy Market Revenue
Solar PV	Hourly LMP multiplied by hourly output level based on solar output model developed using historical hourly output pattern of all PJM solar generation
Onshore Wind	Hourly LMP multiplied by hourly output level based on wind output model developed using historical hourly output pattern of all PJM wind generation
Offshore Wind	Average annual LMP multiplied by annual wind energy output at 45% capacity factor
Battery Storage	Simulated dispatch with commitment for 4 highest LMP hours of a daily 24 hour period if the average LMP of 4 lowest LMP hours exceeds 120% of average LMP of 4 highest LMP hours of the 24 hour period. Net revenues equal hourly MW output times hourly LMP for each hour discharging minus hourly MW consumed times hourly LMP when charging.

Capital Cost Sources

Source	Link
NREL: 2019 Annual Technology Baseline	atb.nrel.gov
Lazard: 2019 Levelized Cost of Energy & Storage	https://www.lazard.com/perspective/lcoe2019
	https://www.lazard.com/media/451087/lazards-levelized-cost-of-storage-version-50-vf.pdf
	https://www.lazard.com/media/451086/lazards-levelized-cost-of-energy-version-130-vf.pdf
EPA: IPM Platform 2018 Reference Case	https://www.epa.gov/airmarkets/documentation-ipm-platform-v6-november-2018-reference-case-all-chapters
EIA: 2020 Capital Cost Report	https://www.eia.gov/analysis/studies/powerplants/capitalcost/
PJM: Quadrennial Review	https://pjm.com/-/media/library/reports-notices/special-reports/2018/20180420-pjm-2018-cost-of-new-entry-study.ashx?la=en

Installed Capital Costs from Different Sources ($/kW)

Technology	NREL 2019	NREL 2022	Lazard 2019	EPA 2021	EIA 2019	PJM
Nuclear	6,648	6,506	6,900 – 12,200	5,644	6,041	6,041
Coal	3,999 – 6,149	3,944 – 6,030	3,000 – 6,250	3,580	3,676 – 5,876	3,676
Combined Cycle	913	894	700 – 1,300	1,081	1,084 (H)	874
Combustion Turbine	916	905	700 – 950	662	713 (7FA)	875
Solar PV	962 – 1,115	833 – 1,113	900 – 1,100	1,034	1,313	1,313
Onshore Wind	1,535 – 1,610	1,435 – 1,623	1,100 – 1,500	1,404	1,677	1,677
Offshore Wind	2,846 – 6,323	2,628 – 6,323	2,350 – 3,550	4,529	4,375	4,375
Battery – 4 hr	1,323 – 1,484	984 – 1,414	898 – 1,874	N/A	1,389	1,389