

Quadrennial Review Issues

MIC - Quadrennial Review
June 30, 2025

IMM



Monitoring Analytics

IMM Package

In a well designed market, prices should reflect underlying supply and demand fundamentals

Reference Resource

- **CT with dual fuel capability**
 - The use of CC Gross CONE as the maximum price is a market design choice that is not well supported
- **Forward E&AS**

VRR Curve

- **Maximum price (Point A) should be set at $1.5 \times \text{Net CONE}$, not to exceed Gross CONE**
- **Point B should be $0.5 \times \text{Maximum Price}$**
- **Point C should be \$0**

Overview of IMM CONE Review Process

- **Monitoring Analytics, LLC (“MA”) retained Pasteris Energy, Inc. to develop the revenue requirements of a new entrant (“CONE”) combustion turbine (“CT”) and combined cycle (“CC”) power plant located in five (5) PJM Locational Deliverability Areas (“LDA”) on a 2028 dollar basis for commercial operation in the 2028-2029 capacity year as part of the PJM RPM 2024 Quad-Review.**

Overview of IMM CONE Review Process

- **Stantec Consulting Services, Inc. (“Stantec”)** a power plant design and engineering firm with CT and CC plant design experience was contracted by Pasteris Energy, Inc. to determine the plant proper capital cost estimate for the CONE CT and CC power plant at the five locations within PJM.
- **Stantec assembled these estimates based upon recent major equipment CT and CC Power Island cost quotes from GE and balance of plant (“BOP”) equipment quotations.**

GE quotes obtained April 21, 2025.

Overview of IMM CONE Review Process

- **The power plant construction estimates were developed based on data from recent actual construction proposals by Stantec and input obtained from multiple construction contractors. For these estimates labor rates and labor productivity for each CONE Area were verified and used to develop the direct and indirect construction costs. The plant proper estimate is an engineering, procurement and construction (“EPC”) turnkey cost estimate in overnight mid-year 2028 dollars.**



IMM Gross and Net CONE

IMM CT Gross & Net CONE						
	EMAAC	SWMAAC	Rest of RTO	WMAAC	COMED	RTO
Gross CONE (ICAP)	\$552	\$529	\$505	\$496	\$592	\$535
Forward E&AS	\$129	\$281	\$354	\$319	\$195	\$270
Net CONE (ICAP)	\$424	\$248	\$151	\$176	\$397	\$264
Gross CONE (UCAP)	\$717	\$687	\$656	\$644	\$768	\$695
Net CONE (UCAP)	\$550	\$322	\$196	\$229	\$515	\$343

IMM CC Gross & Net CONE						
	EMAAC	SWMAAC	Rest of RTO	WMAAC	COMED	RTO
Gross CONE (ICAP)	\$648	\$594	\$591	\$581	\$743	\$631
Forward E&AS	\$234	\$447	\$521	\$478	\$340	\$417
Net CONE (ICAP)	\$413	\$148	\$71	\$103	\$403	\$214
Gross CONE (UCAP)	\$800	\$734	\$730	\$717	\$917	\$780
Net CONE (UCAP)	\$510	\$182	\$87	\$127	\$497	\$265

IMM COMED Battery Gross CONE		
\$ in millions	Conservative	Moderate
Total Project Overnight Cost (2028\$)	\$436	\$342
Total Project Overnight Cost 2028 (\$/kW)	\$2,178	\$1,711
Total Project Installed Cost (2028\$)	\$472	\$371
Total Project Installed Cost 2028 (\$/kW)	\$2,361	\$1,854
Gross CONE (ICAP)	\$749	\$543

IMM forwards as of May 23, 2025.

COMED CT Gross CONE is levelized over 15 years. All other Gross CONE values are levelized over 20 years.

IMM did not limit the CT to 40 percent capacity factor.

IMM used \$5.30/MWh VOM for the CT (\$0.40/MWh consumables + \$4.90/MWh major maintenance).

IMM used \$2.80/MWh VOM for the CC (\$0.60/MWh consumables + \$2.20/MWh major maintenance).

CT Unit Details

Model	GE Frame 7HA.03 CT
Description	CT with evaporative coolers, wet compression, SCR for NOx reduction, CO converter, and dual fuel capability
Configuration	1 × 0
Dual-Fuel Capability	Yes
Firm Gas Transportation Contract	No
ICAP by CONE Area (MW)	438 / 435 / 425 / 432 / 427
Net Heat Rate (Btu/kWh)	9,065
Equivalent Availability Factor (EAF)	88.9%

CT Gross CONE Comparison

\$ in millions	IMM CT Capital Costs Dual Fuel - GE Frame 7HA.03 (2028\$)				
	EMAAC	SWMAAC	Rest of RTO	WMAAC	COMED
ICAP (MW)	438	435	425	432	427
Owner Furnished Equipment (OFE)	\$225	\$225	\$225	\$225	\$225
EPC Costs	\$200	\$177	\$186	\$185	\$209
OFE + EPC Costs	\$424	\$402	\$410	\$410	\$434
Electric Interconnect/System Upgrades	\$14	\$13	\$13	\$13	\$14
Gas Interconnect	\$20	\$19	\$20	\$20	\$21
Equipment Spares	\$7	\$7	\$7	\$7	\$7
Initial Fuel and Other Inventory	\$5	\$5	\$5	\$5	\$5
Mobilization and Startup	\$3	\$3	\$3	\$3	\$3
Land Purchase/Land Reservation Payment	\$3	\$1	\$1	\$1	\$2
Development Expenses	\$8	\$8	\$8	\$8	\$8
Legal Fees	\$3	\$3	\$3	\$3	\$3
Permits	\$3	\$3	\$3	\$3	\$3
Emission Reduction Credits	\$43	\$43	\$1	\$1	\$1
Financing Fees	\$6	\$5	\$5	\$5	\$5
Owner's Contingency	\$11	\$10	\$10	\$10	\$11
Sales Tax	\$1	\$1	\$0	\$0	\$1
Additional Escalations	\$3	\$3	\$2	\$2	\$2
Net Start Up Fuel	-	-	-	-	-
Non-EPC Costs	\$127	\$123	\$80	\$80	\$84
Total Project Overnight Cost (2028\$)	\$552	\$525	\$490	\$490	\$518
Total Project Overnight Cost 2028 (\$/kW)	\$1,259	\$1,208	\$1,154	\$1,133	\$1,214
Total Project Installed Cost (2028\$)	\$607	\$577	\$542	\$541	\$572
Total Project Installed Cost 2028 (\$/kW)	\$1,385	\$1,328	\$1,275	\$1,251	\$1,341

	Brattle CT Capital Costs Dual Fuel - GE Frame 7HA.03 (2028\$)				
	EMAAC	SWMAAC	Rest of RTO	WMAAC	COMED
	392	395	387	383	393
	\$212	\$212	\$212	\$212	\$212
	\$226	\$208	\$209	\$216	\$247
	\$438	\$420	\$421	\$427	\$473
	\$22	\$22	\$22	\$22	\$22
	\$35	\$35	\$35	\$35	\$35
	\$2	\$2	\$2	\$2	\$2
	\$4	\$4	\$4	\$4	\$4
	\$4	\$4	\$4	\$4	\$5
	\$1	\$1	\$0	\$1	\$1
	\$22	\$21	\$21	\$21	\$24
	\$0	\$0	\$0	\$0	\$0
	\$0	\$0	\$0	\$0	\$0
	\$0	\$0	\$0	\$0	\$0
	\$12	\$11	\$11	\$11	\$13
	\$7	\$7	\$7	\$7	\$8
	\$0	\$0	\$0	\$0	\$0
	-	-	-	-	-
	(\$1)	\$0	(\$2)	(\$3)	\$1
	\$109	\$108	\$105	\$105	\$114
	\$547	\$528	\$526	\$532	\$587
	\$1,395	\$1,339	\$1,361	\$1,390	\$1,495
	\$672	\$651	\$648	\$655	\$722
	\$1,715	\$1,647	\$1,674	\$1,710	\$1,837

COMED CT Gross CONE is levelized over 15 years. All other Gross CONE values are levelized over 20 years.

CT Fixed O&M Comparison

\$ in millions	IMM CT Fixed O&M - GE Frame 7HA.03 (2028\$)				
	EMAAC	SWMAAC	Rest of RTO	WMAAC	COMED
Site O&M Labor	\$2.2	\$2.1	\$2.1	\$2.1	\$2.1
O&M Contract Parts and Labor	\$0.7	\$0.7	\$0.7	\$0.7	\$0.7
LTSA Fixed Fee	\$0.5	\$0.5	\$0.5	\$0.5	\$0.5
O&M Management Fees	\$0.2	\$0.2	\$0.2	\$0.2	\$0.2
Electric Purchases	\$0.4	\$0.4	\$0.4	\$0.4	\$0.4
Employee Training Expenses	\$0.1	\$0.1	\$0.1	\$0.1	\$0.1
Insurance	\$2.3	\$2.2	\$2.3	\$2.3	\$2.4
General and Administrative Expenses	\$0.3	\$0.3	\$0.3	\$0.3	\$0.3
Property Taxes	\$1.5	\$1.5	\$0.4	\$0.4	\$0.6
Other	-	-	-	-	-
Total Fixed O&M	\$8.3	\$8.0	\$7.1	\$7.0	\$7.3

	IMM CT Variable O&M (2028\$)				
	EMAAC	SWMAAC	Rest of RTO	WMAAC	COMED
Major Maintenance - Starts Based (\$/Start)	-	-	-	-	-
Consumables, Waste Disposal, Other VOM (\$/MWh)	\$0.4	\$0.4	\$0.4	\$0.4	\$0.4
Major Maintenance (\$/MWh)	\$4.9	\$4.9	\$4.9	\$4.9	\$4.9

	Brattle CT Fixed O&M - GE Frame 7HA.03 (2028\$)				
	EMAAC	SWMAAC	Rest of RTO	WMAAC	COMED
	\$1.2	\$1.3	\$0.9	\$1.0	\$1.1
	\$0.5	\$0.5	\$0.5	\$0.5	\$0.5
	\$0.5	\$0.5	\$0.5	\$0.5	\$0.5
	\$0.6	\$0.7	\$0.5	\$0.5	\$0.6
	-	-	-	-	-
	-	-	-	-	-
	\$3.3	\$3.2	\$3.2	\$3.2	\$3.5
	\$0.3	\$0.3	\$0.3	\$0.3	\$0.3
	\$0.5	\$6.7	\$3.4	\$0.6	\$0.5
	\$0.2	\$0.2	\$0.2	\$0.2	\$0.2
	\$7.0	\$13.2	\$9.2	\$6.8	\$7.2

	Brattle CT Variable O&M (2028\$)				
	EMAAC	SWMAAC	Rest of RTO	WMAAC	COMED
	\$33,007	\$33,007	\$33,007	\$33,007	\$33,007
	\$1.1	\$1.1	\$1.0	\$1.1	\$1.1
	-	-	-	-	-

CC Unit Details

Model	GE Frame 7HA.03 CC
Description	Each CC with a single CT, HRSG, and steam turbine, equipped with CT evaporative cooler and wet compression, SCR for NOx reduction, CO converter, air cooled condensers, duct burners, and dual fuel capability
Configuration	2 trains of 1×1 single shaft
Dual-Fuel Capability	Yes
Firm Gas Transportation Contract	No
ICAP by CONE Area (MW)	1,420 / 1,411 / 1,385 / 1,406 / 1,390
Net Heat Rate (Btu/kWh)	6,564
Equivalent Availability Factor (EAF)	84.4%

CC Gross CONE Comparison

\$ in millions	IMM CC Capital Costs Dual Fuel - GE Frame 7HA.03 (2028\$)				
	EMAAC	SWMAAC	Rest of RTO	WMAAC	COMED
ICAP (MW)	1,420	1,411	1,385	1,406	1,390
Owner Furnished Equipment (OFE)	\$567	\$567	\$567	\$567	\$567
EPC Costs	\$1,044	\$895	\$952	\$946	\$1,135
OFE + EPC Costs	\$1,611	\$1,462	\$1,519	\$1,513	\$1,703
Electric Interconnect/System Upgrades	\$40	\$36	\$37	\$37	\$42
Gas Interconnect	\$28	\$26	\$27	\$27	\$30
Water and Sewer Connection	\$8	\$7	\$7	\$7	\$8
Equipment Spares	\$12	\$12	\$12	\$12	\$12
Initial Fuel and Other Inventory	\$10	\$10	\$10	\$10	\$10
Mobilization and Startup	\$7	\$6	\$7	\$7	\$7
Land Purchase/Land Reservation Payment	\$9	\$5	\$3	\$4	\$7
Development Expenses	\$11	\$11	\$11	\$11	\$11
Legal Fees	\$3	\$3	\$3	\$3	\$3
Permits	\$4	\$4	\$4	\$4	\$4
Emission Reduction Credits	\$105	\$105	\$5	\$5	\$5
Financing Fees	\$20	\$18	\$18	\$18	\$20
Owner's Contingency	\$40	\$37	\$38	\$38	\$43
Sales Tax	\$2	\$2	\$2	\$2	\$2
Additional Escalations	\$21	\$19	\$16	\$16	\$19
Net Start Up Fuel	-	-	-	-	-
Non-EPC Costs	\$321	\$300	\$200	\$200	\$222
Total Project Overnight Cost (2028\$)	\$1,932	\$1,762	\$1,719	\$1,713	\$1,925
Total Project Overnight Cost 2028 (\$/kW)	\$1,360	\$1,249	\$1,241	\$1,219	\$1,385
Total Project Installed Cost (2028\$)	\$2,275	\$2,077	\$2,037	\$2,030	\$2,277
Total Project Installed Cost 2028 (\$/kW)	\$1,602	\$1,472	\$1,471	\$1,444	\$1,639

	Brattle CC Capital Costs Firm Gas - GE Frame 7HA.03 (2028\$)				
	EMAAC	SWMAAC	Rest of RTO	WMAAC	COMED
	1,289	1,289	1,276	1,264	1,294
	\$542	\$542	\$542	\$542	\$576
	\$1,142	\$1,013	\$1,014	\$1,066	\$1,255
	\$1,684	\$1,555	\$1,556	\$1,608	\$1,831
	\$72	\$72	\$71	\$70	\$72
	\$49	\$49	\$49	\$49	\$49
	-	-	-	-	-
	\$8	\$8	\$8	\$8	\$9
	-	-	-	-	-
	\$17	\$16	\$16	\$16	\$18
	\$6	\$6	\$3	\$6	\$7
	\$84	\$78	\$78	\$80	\$92
	-	-	-	-	-
	-	-	-	-	-
	\$2	\$2	\$2	\$2	\$2
	\$42	\$39	\$39	\$40	\$46
	\$17	\$17	\$16	\$16	\$19
	-	-	-	-	-
	-	-	-	-	-
	(\$25)	(\$21)	(\$26)	(\$31)	(\$12)
	\$273	\$265	\$255	\$256	\$302
	\$1,956	\$1,820	\$1,811	\$1,864	\$2,133
	\$1,517	\$1,411	\$1,419	\$1,476	\$1,649
	\$2,487	\$2,314	\$2,305	\$2,372	\$2,712
	\$1,929	\$1,795	\$1,806	\$1,877	\$2,096

COMED CC Gross CONE is levelized over 15 years. All other Gross CONE values are levelized over 20 years.

CC Fixed O&M Comparison

\$ in millions	IMM CC Fixed O&M - GE Frame 7HA.03 (2028\$)				
	EMAAC	SWMAAC	Rest of RTO	WMAAC	COMED
Site O&M Labor	\$5.5	\$5.3	\$5.4	\$5.4	\$5.2
O&M Contract Parts and Labor	\$3.6	\$3.3	\$3.4	\$3.4	\$3.8
LTSA Fixed Fee	\$1.1	\$1.1	\$1.1	\$1.1	\$1.1
O&M Management Fees	\$0.4	\$0.4	\$0.4	\$0.4	\$0.4
Electric Purchases	\$0.5	\$0.5	\$0.5	\$0.5	\$0.5
Employee Training Expenses	\$0.2	\$0.2	\$0.2	\$0.2	\$0.2
Insurance	\$8.6	\$7.8	\$8.1	\$8.1	\$9.1
General and Administrative Expenses	\$1.3	\$1.3	\$1.3	\$1.3	\$1.3
Property Taxes	\$5.3	\$5.0	\$2.4	\$2.3	\$3.3
Firm Gas Contract	-	-	-	-	-
Other	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0
Total Fixed O&M	\$26.4	\$24.8	\$22.8	\$22.7	\$24.9

	IMM CC Variable O&M (2028\$)				
	EMAAC	SWMAAC	Rest of RTO	WMAAC	COMED
Major Maintenance - Starts Based (\$/Start)	-	-	-	-	-
Consumables, Waste Disposal, Other VOM (\$/MWh)	\$0.6	\$0.6	\$0.6	\$0.6	\$0.6
Major Maintenance (\$/MWh)	\$2.2	\$2.2	\$2.2	\$2.2	\$2.2

	Brattle CC Fixed O&M - GE Frame 7HA.03 (2028\$)				
	EMAAC	SWMAAC	Rest of RTO	WMAAC	COMED
	\$5.3	\$5.7	\$3.9	\$4.7	\$5.1
	\$7.8	\$8.0	\$7.0	\$7.5	\$7.7
	\$1.1	\$1.1	\$1.1	\$1.1	\$1.1
	\$1.7	\$1.8	\$1.2	\$1.4	\$1.6
	-	-	-	-	-
	-	-	-	-	-
	\$11.7	\$10.9	\$10.9	\$11.2	\$12.8
	\$1.6	\$1.6	\$1.6	\$1.6	\$1.6
	\$3.3	\$22.9	\$12.6	\$4.2	\$3.1
	\$10.7	\$20.4	\$26.2	\$18.7	\$8.6
	\$0.6	\$0.5	\$0.5	\$0.5	\$0.6
	\$44.0	\$73.0	\$65.1	\$50.9	\$42.3

	Brattle CC Variable O&M (2028\$)				
	EMAAC	SWMAAC	Rest of RTO	WMAAC	COMED
	-	-	-	-	-
	\$0.8	\$0.8	\$0.8	\$0.8	\$0.8
	\$1.9	\$1.9	\$1.9	\$1.9	\$1.9

COMED Battery

- Not well supported by the market
- In 2024 all PJM batteries had < \$0/MWh E&AS and positive ancillary revenue

	Battery Units in PJM		
	Current	Retired	Total
COMED	7	4	11
PJM (excl. COMED)	27	6	33
Total	34	10	44

VRR Curve

- In a well designed market, prices should reflect underlying supply and demand fundamentals
- The use of CC Gross CONE as the maximum price is a market design choice that is not well supported
- Reference resource should be a CT with dual fuel capability
- Maximum price (Point A) should be set at $1.5 \times \text{Net CONE}$, not to exceed Gross CONE
- Point B should be $0.5 \times \text{Maximum Price}$
- Point C should be \$0

VRR Curve

MW in UCAP	VRR Curve Points					
	EMAAC	SWMAAC	Rest of RTO	WMAAC	COMED	RTO
a1) CT Gross CONE	\$717	\$687	\$656	\$644	\$768	\$695
a2) 1.5 x CT Net CONE	\$826	\$484	\$294	\$343	\$772	\$515
Point A (min of a1, a2)	\$717	\$484	\$294	\$343	\$768	\$515
Point B (0.5 x Point A)	\$359	\$242	\$147	\$172	\$384	\$258
Point C	\$0	\$0	\$0	\$0	\$0	\$0

COMED CT Gross CONE is levelized over 15 years. All other Gross CONE values are levelized over 20 years.



Core Issue

- **Broader goal is to address underlying issue/cause of tight supply-demand conditions in the capacity market.**
- **The current conditions are not the result of organic load growth.**
- **The current conditions in the capacity market are almost entirely the result of load additions from data centers, both actual historical and forecast**
- **This is not a reason to introduce cost of service regulation through an accelerated/distorted version of reliability backstop**
- **The solution includes:**
 - **Planning queue for large load additions**
 - **Large new loads should be added only if they can be served reliably**
 - **Requirement for large loads to bring your own generation**

Monitoring Analytics, LLC

2621 Van Buren Avenue

Suite 160

Eagleview, PA

19403

(610) 271-8050

MA@monitoringanalytics.com

www.MonitoringAnalytics.com

