GRAIN BELT EXPRESS PRICE STUDY

March 2023

CONFIDENTIAL & PROPRIETARY

AGENDA

- Project Objective
- Modeling Assumptions
  - Wind capacity factor
  - Henry hub gas price
  - Scenario analysis flowchart
  - Latest MISO MTEP data
- Study Summary
  - Annual/Monthly average LMPs
  - Revised retirement sensitivity
  - Impacts on LMP components
- Appendix

PROJECT OBJECTIVE

Price Node Names
AMMO.MOBCTG1
AMMO.PENOCTG1
EAI.PLUM1_MEUC
AMIL.PSG1.MEUC
ALTW.CRLK3CWLD
MEC.FARMER
AECI

Price Node Names
Injection to AECI
Injection to MISO
AMMO.HANN_1.AZ
SWPP
CWLD.CWLD
AMMO.KIRK
WR.MOWR

- Determine the price impact wind generation will have by flowing through the Grain Belt Express and injecting into both MISO & AECI
- Deliverables for the project will include monthly/annual average LMPs of the listed locations/hubs

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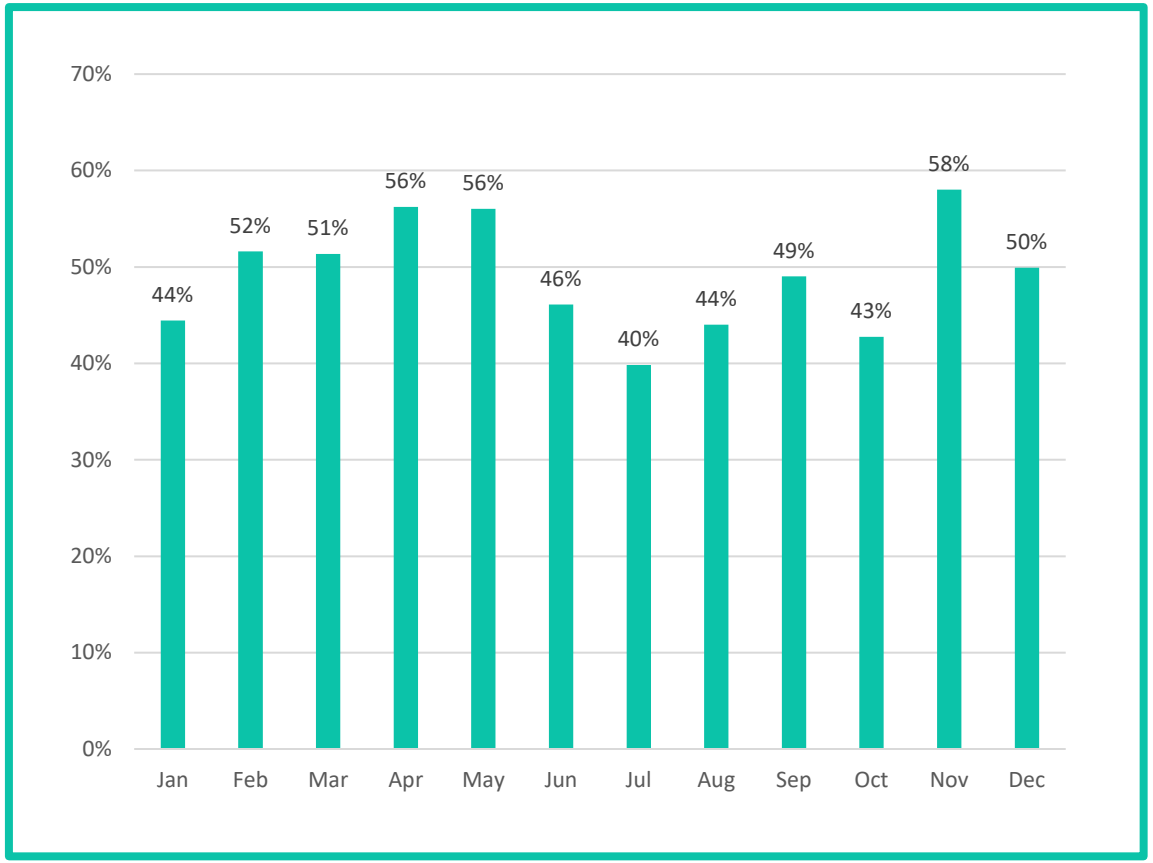
GENERAL MODELING ASSUMPTIONS

- Grain Belt Express would be online prior to 1/1/2028
- Study duration was calendar year 2028
- Software: CES' Dayzer, MISO model
  - TEA leveraged the vendor's database for projected generation and transmission assumptions
  - Wind profile is based on CES modeled profile for Santa Fe Trail Wind in the year of 2028
  - Three natural gas price (NYMEX Henry Hub) forwards were used in various scenarios to determine fuel price impacts on market-wide LMPs
    - Base Case (BASE): 1/23/2023
    - High Prices (HG): 9/2/2022
    - Low Prices (LG): 5/14/2020

Note: Additional CES model details can be found in Appendix

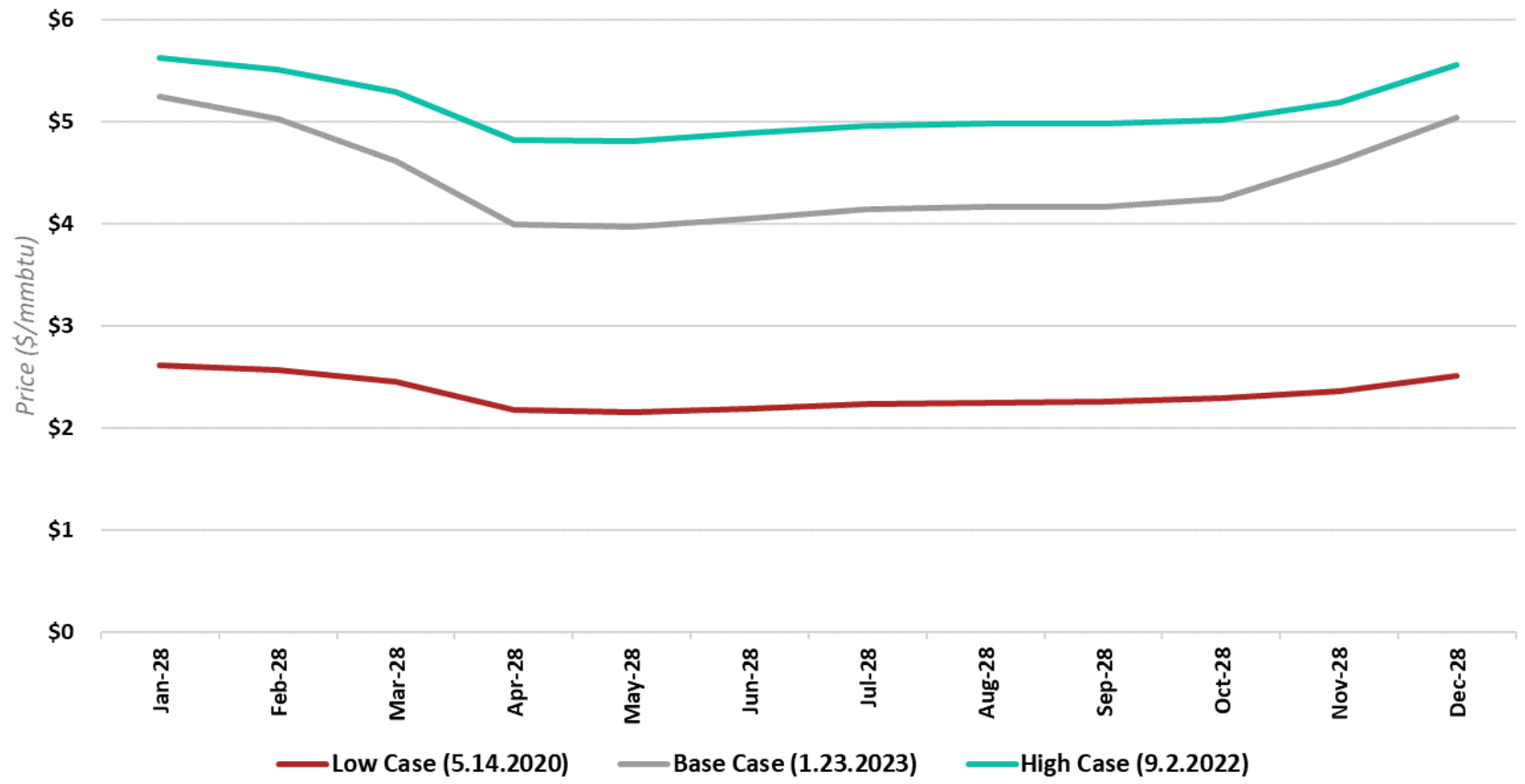
WIND CAPACITY FACTOR IS 49% AND OFFER PRICE IS -$22/MWH



- Wind profile is based on CES modeled profile for Santa Fe Trail Wind in the year of 2028
- The same wind profile was used for injections to MISO and AECI
- Feb, Mar, Apr, May and Nov, Dec are wind strong months
- Default Dayzer Wind model was used, and the offer price is -$22/MWh
  - -$22/MWh is the Dayzer default Production Tax Credit (PTC) value for a Wind generator
  - It is then assumed to be the bid price for all PTC eligible Wind generation
  - Wind generator bid prices can vary due to the coupling of federal, state, and local production tax opportunity

HENRY HUB GAS PRICE SCENARIOS

Average Annual Price: Low Case ($2.34), Base Case ($4.35), High Case ($5.14)



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SCENARIO ANALYSIS DETAIL

Business as Usual ("BAU") Case: This scenario assumed the MISO system, with known generation retirements/additions and transmission infrastructure changes, to determine a baseline by which to evaluate the impact of successive scenarios

Grain Belt Express ("GBE") Case: This scenario will continue the assumptions made in the BAU case, yet it adds injections from the Grain Belt Express based on scaled wind farm output

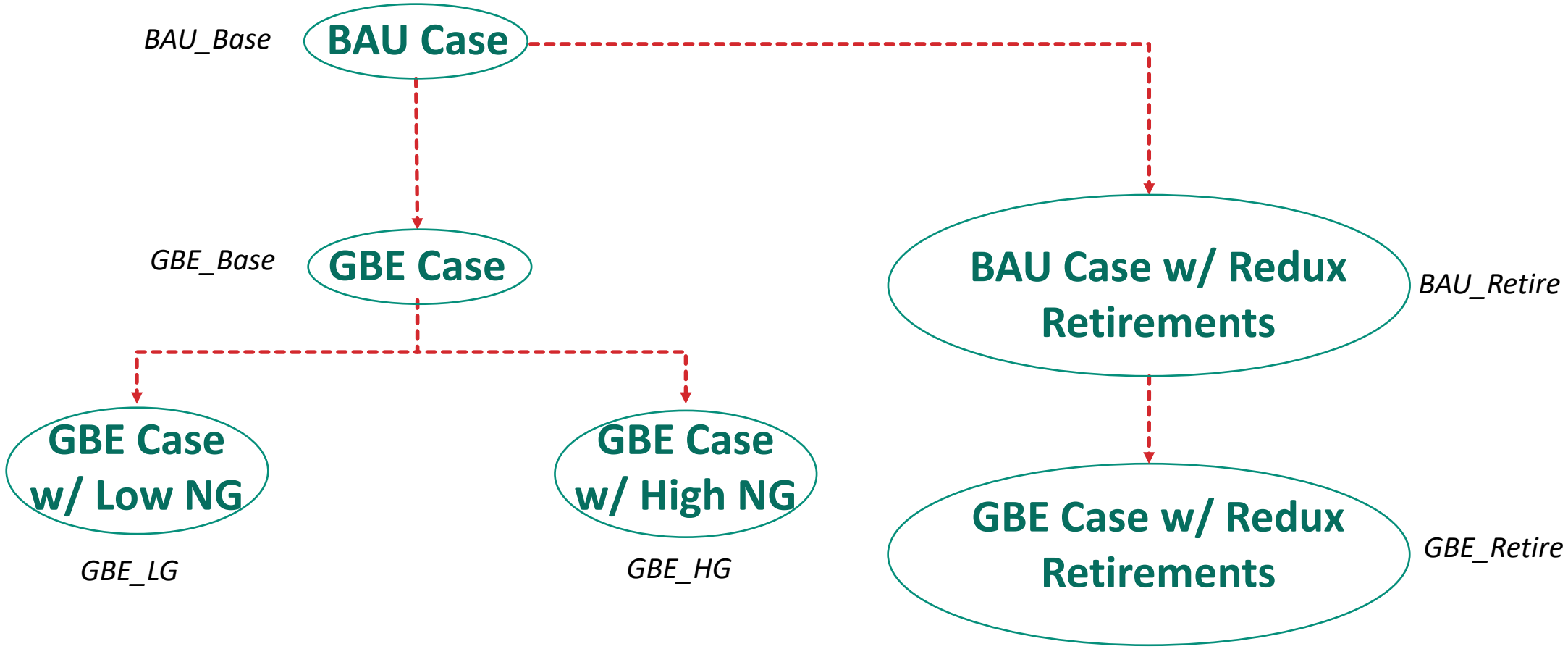
GBE (Change Case) includes the following modifications:

- Injecting 1,500 MW on Ameren's McCredie – Montgomery 345kV line tap into the MISO system and 1,000 MW at the McCredie Substation to the AECI system
- Two new 345kV lines were added between McCredie and Montgomery 345kV substations
- The injection of wind is scaled up based on existing wind farm (Santa Fe Trail Wind, capacity factor of 49%)

Revised Retirements Case: This scenario reduced the amount of retired MISO capacity by retaining ~7.6GW existing generation that would have an operation life of less than 60-years by 2028 (revised retirement case results are designated with the "retire" notation)

Note: Additional revised retirement case details can be found in Appendix

SCENARIO ANALYSIS FLOWCHART



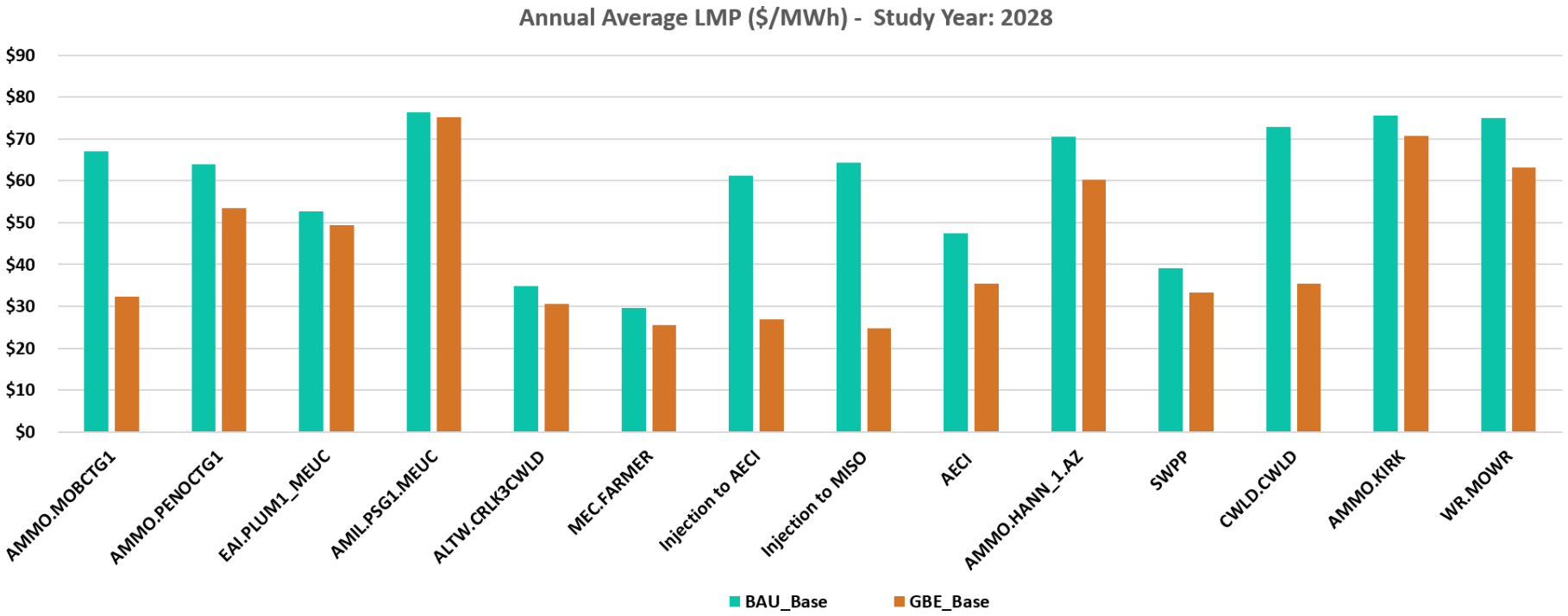
SUMMARY

- The annual/monthly average LMP ($/MWh) at the requested nodes from BAU_Base case and GBE_Base case were compared
  - With GBE project in place, the LMPs had an annual average drop ranging from $1.10/MWh (AMIL.PSG1.MEUC) to $37.56/MWh (CWLD.CWLD) after the injection of GBE wind generation into AECI and MISO system

- In the Revised Retirements scenario, the annual/monthly average LMP ($/MWh) at the requested nodes from BAU_Retire case and GBE_Retire case were compared
  - With GBE project in place, LMPs had an annual average drop ranging from $1.04/MWh to $30.79/MWh (MISO Injection node) after the injection of a significant amount of wind generation to AECI and MISO system

**Study results are based on the current assumptions Dayzer modeled for year 2028*

ANNUAL AVERAGE LMP DROPPED WHEN GBE IN PLACE



Node/Zone Name	BAU_Base	GBE_Base
AMMO.MOBCTG1	67.13	32.31
AMMO.PENOCTG1	64.02	53.47
EAI.PLUM1_MEUC	52.69	49.47
AMIL.PSG1.MEUC	76.38	75.28
ALTW.CRLK3CWLD	34.90	30.54
MEC.FARMER	29.72	25.49
Injection to AECI	61.30	27.13
Injection to MISO	64.42	24.95
AECI	47.49	35.42
AMMO.HANN_1.AZ	70.59	60.19
SWPP	39.09	33.36
CWLD.CWLD	72.93	35.37
AMMO.KIRK	75.53	70.71
WR.MOWR	75.08	63.25

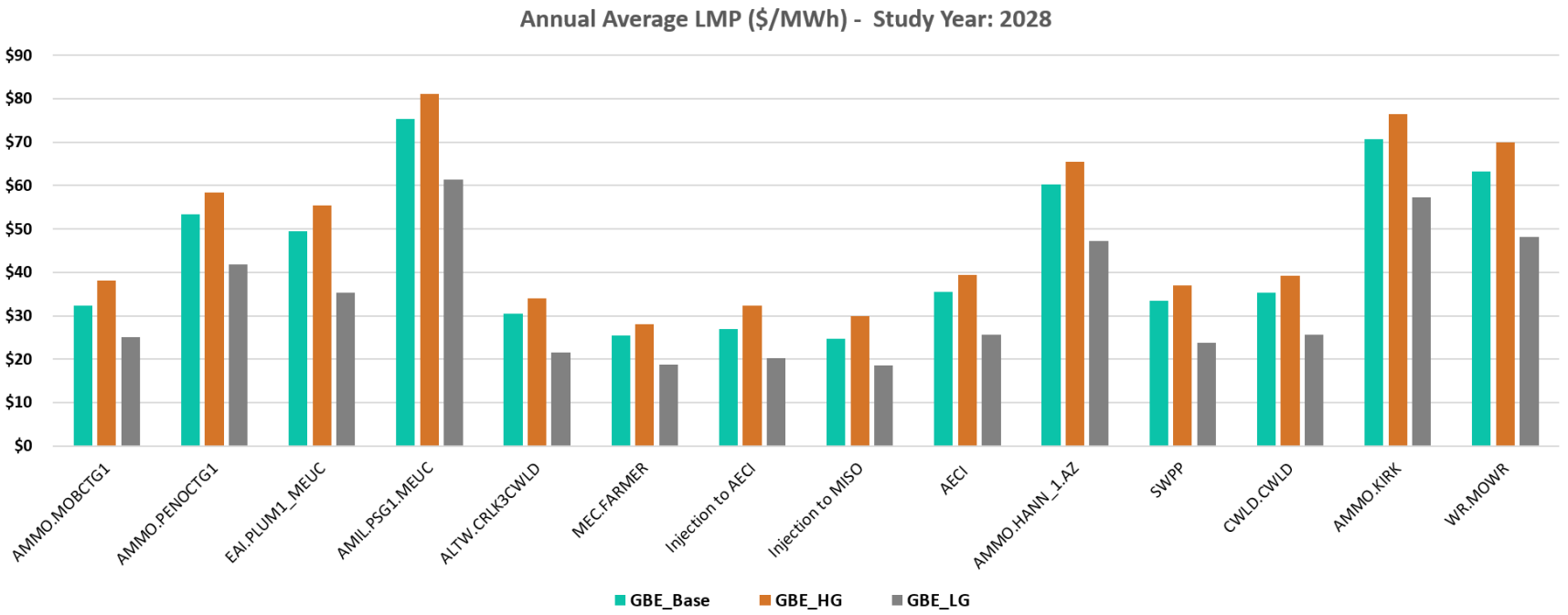
Averages	59.38	44.07

Deltas vs. BAU_Base	(15.31)

As compared to BAU Base Case:

- Generation/Load node prices move as expected with the injection of GBE,
  - Reduction in GBE Base case prices
  - All nodes in study show drop in the annual average $/MWh in the GBE case

ANNUAL AVERAGE LMP DROPPED WHEN GBE IN PLACE



Node/Zone Name	GBE_Base	GBE_HG	GBE_LG
AMMO.MOBCTG1	32.31	38.16	25.04
AMMO.PENOCTG1	53.47	58.41	41.80
EAI.PLUM1_MEUC	49.47	55.39	35.38
AMIL.PSG1.MEUC	75.28	81.23	61.32
ALTW.CRLK3CWLD	30.54	33.96	21.55
MEC.FARMER	25.49	28.08	18.68
Injection to AECI	27.13	32.27	20.30
Injection to MISO	24.95	29.94	18.55
AECI	35.42	39.32	25.61
AMMO.HANN_1.AZ	60.19	65.51	47.21
SWPP	33.36	37.07	23.80
CWLD.CWLD	35.37	39.31	25.64
AMMO.KIRK	70.71	76.45	57.38
WR.MOWR	63.25	69.89	48.08

Averages	44.07	48.93	33.60

Deltas vs. GBE_Base		4.86	(10.47)

As compared to GBE Base Case:

- Reduction in prices with Low Natural Gas sensitivity
- Increase in prices with High Natural Gas sensitivity

PRICE DROPPED FOR ALL NODES IN THE REVISED RETIREMENTS SENSITIVITY

Node/Zone Name	GBE_Base	GBE_Retire	Delta (Retire - Base)
AMMO.MOBCTG1	32.31	30.27	(2.04)
AMMO.PENOCTG1	53.47	47.61	(5.86)
EAI.PLUM1_MEUC	49.47	41.88	(7.60)
AMIL.PSG1.MEUC	75.28	56.34	(18.94)
ALTW.CRLK3CWLD	30.54	24.45	(6.08)
MEC.FARMER	25.49	22.31	(3.19)
Injection to AECI	27.13	25.84	(1.30)
Injection to MISO	24.95	23.11	(1.84)
AECI	35.42	31.77	(3.66)
AMMO.HANN_1.AZ	60.19	49.44	(10.75)
SWPP	33.36	29.91	(3.45)
CWLD.CWLD	35.37	31.00	(4.37)
AMMO.KIRK	70.71	55.07	(15.64)
WR.MOWR	63.25	53.28	(9.98)

**Number in the table are Annual average LMPs ($/MWh)*

- The Revised Retirements cases were simulated as sensitivity to mitigate the unusually high LMPs
  - Extended the retirement dates of units expected to be retiring prior to 2028 and are younger than 60 years. Such units' retirement was delayed to be after the study year
  - Compared to the GBE_Base, the GBE_Retire scenario had additional ~7.6 GW thermal generation for 2028. Similar for BAU_Base and BAU_Retire.
- The annual average LMP ($/MWh) at the requested nodes from GBE_Base and GBE_Retire were compared
  - In the Revised Retirements scenario (GBE_Retire), the LMPs had an annual average drop ranging from $1.30/MWh (Inject node to AECI) to $18.94/MWh (AMIL.PSG1.MEUC) due to more available generation to serve nearby loads

GBE_RETIRE: MONTHLY AVERAGE LMP ($/MWH)

GBE_Retire Monthly Avg LMP ($/MWh)

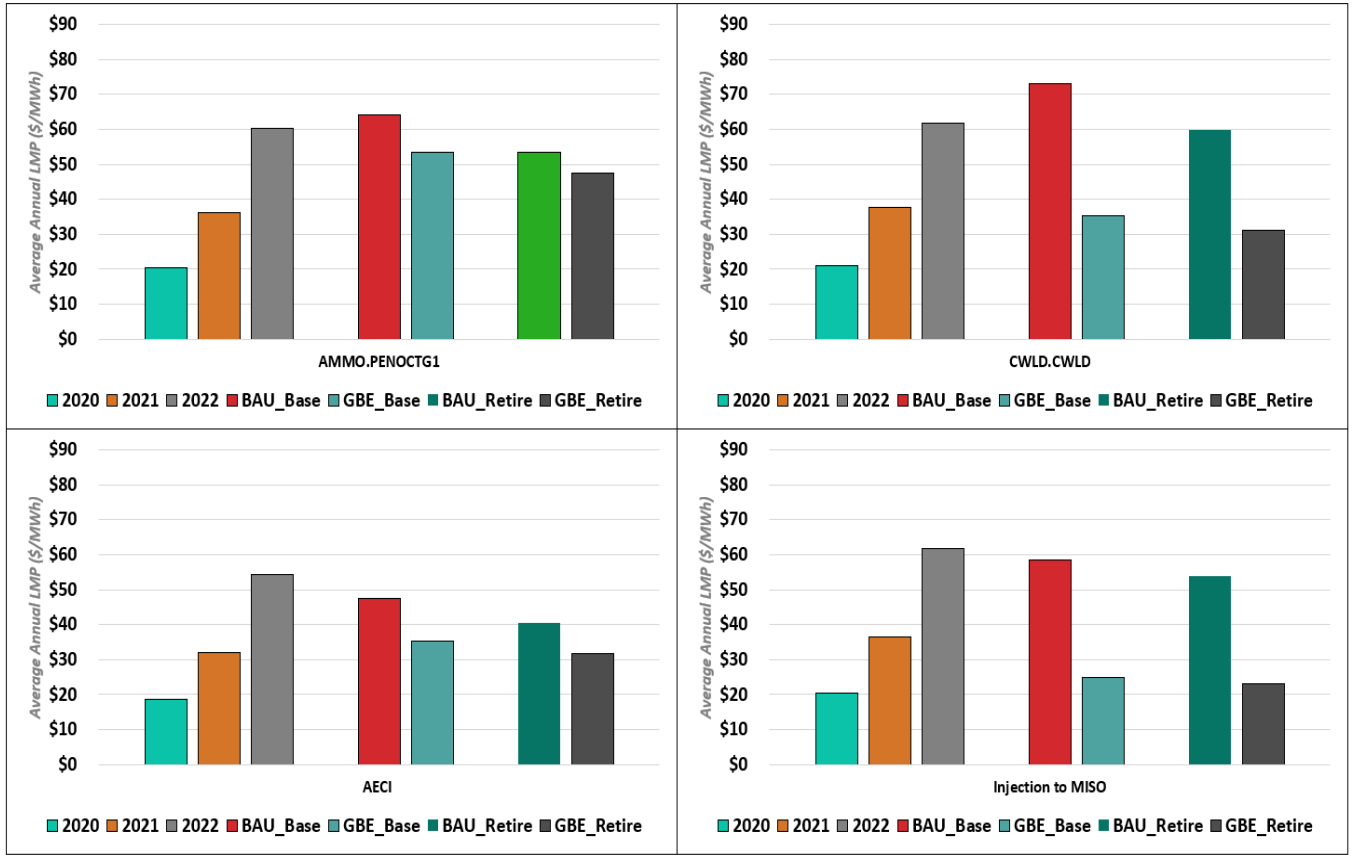
Month	AMMO.MOBCTG1	AMMO.PENOCTG1	EAI.PLUM1_MEUC	AMIL.PSG1.MEUC	ALTW.CRLK3CWLD	MEC.FARMER	AECI	Injection to AECI	Injection to MISO	AMMO.HANN_1.AZ	SWPP	CWLD.CWLD	AMMO.KIRK	WR.MOWR
Jan	61.42	72.45	49.62	78.05	49.82	44.07	53.45	58.04	57.04	77.85	51.89	63.89	77.14	78.16
Feb	36.47	54.68	40.95	54.35	29.07	23.77	34.14	32.06	29.97	58.60	32.95	37.72	55.07	58.05
Mar	29.43	45.78	39.83	52.80	19.84	17.61	27.23	24.95	24.23	49.32	24.94	30.96	51.83	61.11
Apr	10.42	27.63	33.18	44.49	(3.29)	2.22	14.20	4.88	2.74	28.98	12.30	11.25	42.03	40.56
May	10.23	34.19	34.54	46.27	8.20	7.70	16.85	2.87	0.38	30.48	17.12	9.80	45.55	31.65
Jun	24.60	50.71	42.11	57.90	25.23	23.03	28.14	18.47	14.88	48.27	27.14	24.44	56.75	44.75
Jul	38.63	59.79	55.85	68.33	42.54	35.74	41.37	33.97	31.46	59.34	38.63	39.80	67.28	57.43
Aug	35.91	54.12	44.73	58.41	40.24	36.60	40.20	31.75	27.43	51.66	38.87	35.15	58.39	51.13
Sep	26.30	42.55	39.94	54.67	27.66	26.50	31.64	22.12	16.25	43.37	29.95	25.81	51.75	43.21
Oct	31.86	44.76	40.84	51.06	20.43	20.78	33.68	27.78	24.97	45.51	29.66	31.23	50.65	48.58
Nov	22.13	36.07	40.66	50.77	9.34	8.42	25.40	19.91	17.17	44.58	22.99	24.04	47.69	62.21
Dec	35.87	48.64	40.25	58.97	24.33	21.24	34.90	33.22	30.83	55.27	32.50	37.92	56.70	62.49
Annual Averages	**30.27**	**47.61**	**41.88**	**56.34**	**24.45**	**22.31**	**31.77**	**25.84**	**23.11**	**49.44**	**29.91**	**31.00**	**55.07**	**53.28**

- Seasonality of prices continue
- Fall/Spring prices for some nodes drop into the single digit range
- Hub prices hold value across the year
- Prices peak in January for most nodes

PRICE COMPARISON BETWEEN THE HISTORICAL, BASE RETIREMENT AND THE REVISED RETIREMENTS CASES (ANNUAL AVERAGE LMP IN $/MWH)

Historical Prices | Base Retirement Cases | Revised Retirement Cases

Node/Zone Name	2020	2021	2022	BAU Base	GBE Base	Delta (GBE - BAU)	BAU Retire	GBE Retire	Delta (GBE - BAU)
AMMO.MOBCTG1	$19.46	$32.46	$57.12	$67.13	$32.31	($34.82)	$56.26	$30.27	($25.99)
AMMO.PENOCTG1	$20.25	$36.29	$60.37	$64.02	$53.47	($10.55)	$53.51	$47.61	($5.90)
EAI.PLUM1_MEUC	$19.93	$36.18	$61.21	$52.69	$49.47	($3.22)	$42.92	$41.88	($1.04)
AMIL.PSG1.MEUC	$20.54	$33.55	$61.37	$76.38	$75.28	($1.10)	$58.49	$56.34	($2.15)
ALTW.CRLK3CWLD	$13.80	$25.10	$37.64	$34.90	$30.54	($4.36)	$26.72	$24.45	($2.27)
MEC.FARMER	$15.85	$23.28	$37.79	$29.72	$25.49	($4.22)	$24.78	$22.31	($2.47)
Injection to AECI	$21.10	$37.46	$62.97	$73.00	$27.13	($45.87)	$51.69	$25.84	($25.86)
Injection to MISO	$20.33	$36.46	$61.69	$58.37	$24.95	($33.42)	$53.90	$23.11	($30.79)
AECI	$18.50	$32.00	$54.33	$47.49	$35.42	($12.07)	$40.45	$31.77	($8.68)
AMMO.HANN_1.AZ	$22.38	$39.27	$73.97	$70.59	$60.19	($10.40)	$55.40	$49.44	($5.97)
SWPP	$18.22	$32.95	$51.04	$39.09	$33.36	($5.73)	$33.81	$29.91	($3.90)
CWLD.CWLD	$20.99	$37.58	$61.62	$72.93	$35.37	($37.56)	$59.93	$31.00	($28.93)
AMMO.KIRK	$21.08	$37.01	$63.56	$75.53	$70.71	($4.82)	$58.93	$55.07	($3.86)
WR.MOWR	$21.14	$37.22	$65.89	$75.08	$63.25	($11.83)	$59.13	$53.28	($5.85)



Notes:

- *Historical proxy node for Injection to AECI is CWLD.FULT*
- *Historical proxy node for Injection to MISO is AMMO.CALLAWAY1*

SYSTEM-WIDE MARGINAL ENERGY COST REDUCTION

Month	GBE_Retire	BAU_Retire	Delta (GBE - BAU)
Jan	79.82	83.07	(3.25)
Feb	56.85	58.23	(1.38)
Mar	49.51	51.59	(2.08)
Apr	34.99	35.80	(0.81)
May	35.61	36.58	(0.97)
Jun	47.28	48.60	(1.32)
Jul	60.40	62.36	(1.96)
Aug	54.45	56.32	(1.87)
Sep	48.52	50.71	(2.19)
Oct	44.19	45.62	(1.43)
Nov	46.96	48.69	(1.72)
Dec	56.22	58.46	(2.24)
Annual Avg MEC	51.23	53.00	**(1.77)**

Projected 2028 cost savings to serve MISO load by reducing MEC on average $1.77/MWh

	GBE_Retire	BAU_Retire	Delta (GBE_Retire - BAU_Retire)
Annual Energy Cost to Serve Load ($)	$40,259,232,258	$41,415,591,325	($1,156,359,066)
Annual Energy_MISO (MWh)	748,054,275		

- LMP = MEC + MCC + MLC
- MEC – Marginal Energy Component; MCC – Marginal Congestion Component; MLC – Marginal Loss Component

APPENDIX

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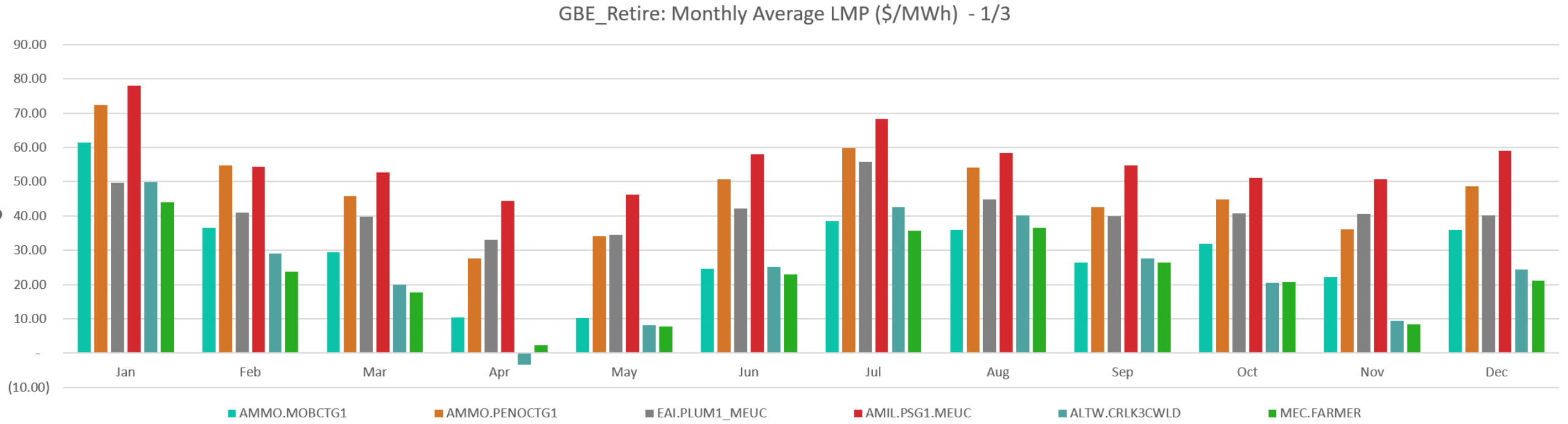
MONTHLY AVERAGE LMP ($/MWH)

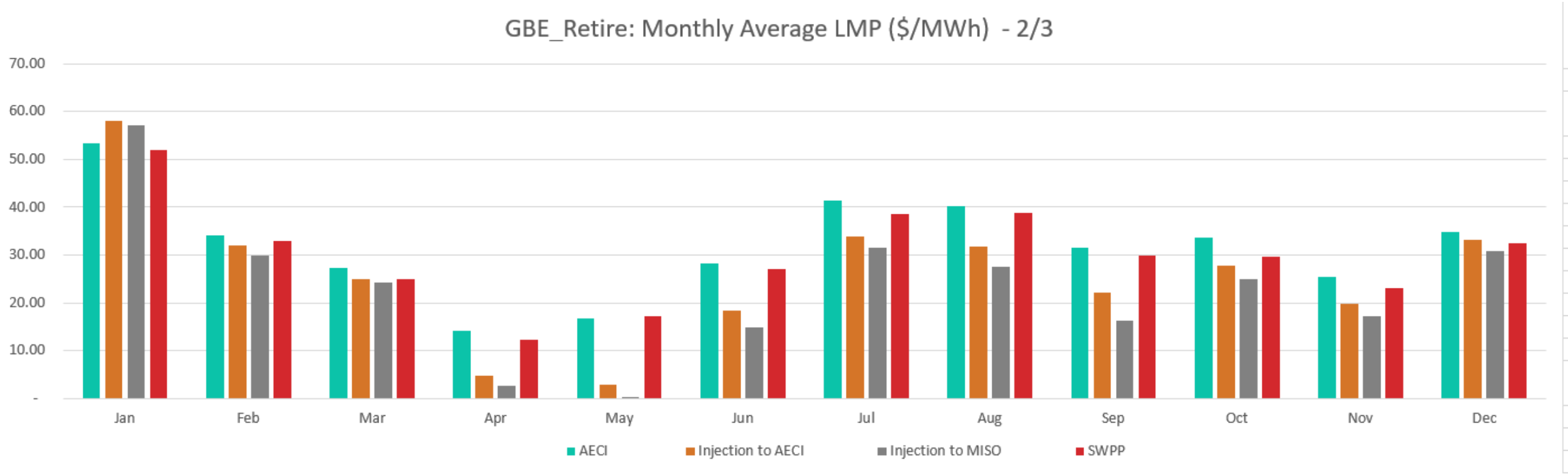
GBE_Retire Monthly Avg LMP ($/MWh)

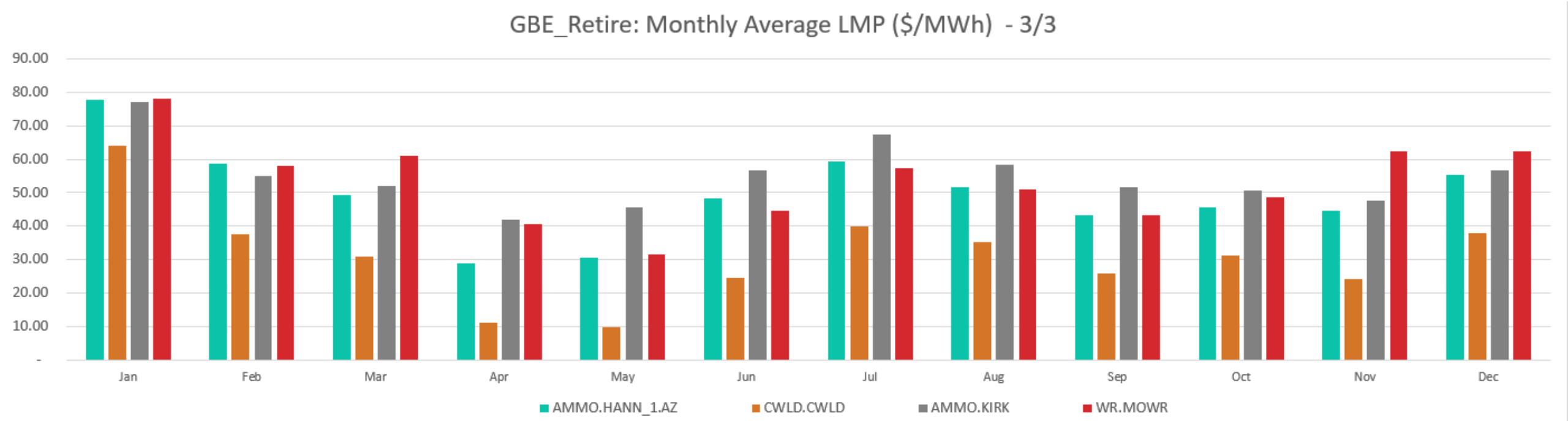
Month	AMMO.MOBCTG1	AMMO.PENOCTG1	EAI.PLUM1_MEUC	AMIL.PSG1.MEUC	ALTW.CRLK3CWLD	MEC.FARMER	AECI	Injection to AECI	Injection to MISO	AMMO.HANN_1.AZ	SWPP	CWLD.CWLD	AMMO.KIRK	WR.MOWR
Jan	61.42	72.45	49.62	78.05	49.82	44.07	53.45	58.04	57.04	77.85	51.89	63.89	77.14	78.16
Feb	36.47	54.68	40.95	54.35	29.07	23.77	34.14	32.06	29.97	58.60	32.95	37.72	55.07	58.05
Mar	29.43	45.78	39.83	52.80	19.84	17.61	27.23	24.95	24.23	49.32	24.94	30.96	51.83	61.11
Apr	10.42	27.63	33.18	44.49	(3.29)	2.22	14.20	4.88	2.74	28.98	12.30	11.25	42.03	40.56
May	10.23	34.19	34.54	46.27	8.20	7.70	16.85	2.87	0.38	30.48	17.12	9.80	45.55	31.65
Jun	24.60	50.71	42.11	57.90	25.23	23.03	28.14	18.47	14.88	48.27	27.14	24.44	56.75	44.75
Jul	38.63	59.79	55.85	68.33	42.54	35.74	41.37	33.97	31.46	59.34	38.63	39.80	67.28	57.43
Aug	35.91	54.12	44.73	58.41	40.24	36.60	40.20	31.75	27.43	51.66	38.87	35.15	58.39	51.13
Sep	26.30	42.55	39.94	54.67	27.66	26.50	31.64	22.12	16.25	43.37	29.95	25.81	51.75	43.21
Oct	31.86	44.76	40.84	51.06	20.43	20.78	33.68	27.78	24.97	45.51	29.66	31.23	50.65	48.58
Nov	22.13	36.07	40.66	50.77	9.34	8.42	25.40	19.91	17.17	44.58	22.99	24.04	47.69	62.21
Dec	35.87	48.64	40.25	58.97	24.33	21.24	34.90	33.22	30.83	55.27	32.50	37.92	56.70	62.49

BAU_Retire Monthly Avg LMP ($/MWh)

Month	AMMO.MOBCTG1	AMMO.PENOCTG1	EAI.PLUM1_MEUC	AMIL.PSG1.MEUC	ALTW.CRLK3CWLD	MEC.FARMER	AECI	Injection to AECI	Injection to MISO	AMMO.HANN_1.AZ	SWPP	CWLD.CWLD	AMMO.KIRK	WR.MOWR
Jan	92.59	83.88	52.13	85.04	53.28	46.24	63.73	86.40	85.13	86.25	56.26	99.69	86.41	89.10
Feb	70.91	60.86	42.05	60.02	31.13	22.97	42.75	64.22	61.15	62.77	35.09	78.91	61.53	63.94
Mar	66.06	54.18	40.96	56.07	22.86	18.04	36.16	58.83	55.57	55.51	27.70	74.07	57.44	58.20
Apr	30.57	33.53	33.91	44.04	(2.04)	3.57	20.74	23.79	36.28	34.89	14.75	32.04	44.31	46.70
May	23.07	34.32	35.01	45.97	10.32	11.78	24.45	18.18	33.93	34.97	22.35	20.17	45.58	43.57
Jun	46.83	50.95	42.37	56.38	28.04	26.70	36.43	43.57	46.58	52.55	31.36	48.75	56.49	53.49
Jul	61.81	63.69	56.87	68.66	45.87	41.18	50.55	59.54	60.07	66.53	44.01	64.47	68.50	66.05
Aug	54.73	55.93	44.54	59.19	43.23	42.65	49.15	54.31	54.33	56.93	44.80	54.26	59.37	58.29
Sep	46.91	47.34	40.37	55.05	29.33	31.75	41.13	45.41	49.28	50.03	35.63	46.11	54.40	52.76
Oct	49.29	48.16	41.64	52.51	22.00	23.19	40.46	45.76	49.93	48.94	33.08	49.53	53.11	52.90
Nov	63.43	50.06	43.02	55.65	10.58	8.18	35.39	56.95	53.76	53.23	24.88	74.06	56.03	59.29
Dec	68.94	59.27	42.15	63.30	26.02	21.09	44.44	63.35	60.85	62.23	35.79	77.09	63.94	65.26


GBE_Retire: Monthly Average LMP ($/MWh) - 1/3
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
-
(10.00)
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
AMMO.MOBCTG1
AMMO.PENOCTG1
EAI.PLUM1_MEUC
AMIL.PSG1.MEUC
ALTW.CRLK3CWLD
MEC.FARMER


GBE_Retire: Monthly Average LMP ($/MWh) - 2/3
70.00
60.00
50.00
40.00
30.00
20.00
10.00
-
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
AECI
Injection to AECI
Injection to MISO
SWPP


GBE_Retire: Monthly Average LMP ($/MWh) - 3/3
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
-
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
AMMO.HANN_1.AZ
CWLD.CWLD
AMMO.KIRK
WR.MOWR

ASSUMPTIONS IN DAYZER

- Dayzer RTO models come from IDC planning model topology + custom additions built on top
- Units modeled in Dayzer come from RTO GIQ that have substantial expectation to be operational in the future
- Units with executed GIAs, Projects mentioned in Press Statements, featured in IRPs are filtered by CES in the model
- The Unit Installation Dates, Capacity and unit characteristics come from RTO and public sources
- Transmission network assumptions are updated based on RTO quarterly reports, Step reports, NTC trackers
- Retirement dates of Units are based on CES's planning studies and public information
- Unit Gen_Schedules for Wind by default comes from CES
- CES uses RTMA (Real Time Mesoscale Analysis) data from NOAA to generate wind schedules based on lat/long of the future units

UNITS DELAYED RETIREMENT DATE IN RETIRE SENSITIVITY SCENARIO

Generation Unit	Zone	Type	Capacity	Submarket	Owner	Unit Id	Installation Date	Retirement Date	LifeSpan
Sioux 1	Central Illinois Public Service	STc+	475	MISO	Ameren	6874	1/1/1970	10/1/2027	57
Sioux 2	Central Illinois Public Service	STc+	475	MISO	Ameren	6875	1/1/1970	10/1/2027	57
Warrick 1	Southern Indiana Gas	STc+	155	MISO	SIGE_CO	11064	11/1/1970	10/1/2027	57
Warrick 2	Southern Indiana Gas	STc+	155	MISO	SIGE_CO	11065	11/1/1970	10/1/2027	57
Warrick 3	Southern Indiana Gas	STc+	155	MISO	SIGE_CO	11066	11/1/1970	10/1/2027	57
Warrick 4	Southern Indiana Gas	STc+	300	MISO	SIGE_CO	7185	11/1/1970	10/1/2027	57
Merom 1	Hoosier Energy	STc+	507	MISO	HEC_CO	6109	1/1/1970	10/1/2026	56
Merom 2	Hoosier Energy	STc+	493	MISO	HEC_CO	6110	1/1/1970	10/1/2026	56
Monroe 3	Detroit Edison	STc+	750	MISO	DECO_CO	6192	5/1/1973	5/31/2028	55
Monroe 4	Detroit Edison	STc+	750	MISO	DECO_CO	6193	5/1/1974	5/31/2028	54
Michigan City 12	Northern Indiana Public Service	STc+	469	MISO	NIPS_CO	6130	5/1/1974	10/1/2026	52
White Bluff 1	Entergy	STc+2	815	MISO South	DEFAULT	7254	8/1/1980	12/31/2027	47
White Bluff 2	Entergy	STc+2	844	MISO South	DEFAULT	7255	7/1/1981	12/31/2028	47
Clinton	Illinois Power - Soyland/Ameren	NU	1073	MISO	IPSP_CO	4733	10/2/2003	5/31/2027	24
Dallman 4	Springfield - Illinois/City Wat	STc+1	200	MISO	SPFI_CO	7395	11/1/2009	5/31/2027	18

BAU Case Retirements

Existing Model Retirment Assumptions (retirements between 2023-2028)							
	Coal	Deisel	Gas	Nuclear	Water	Wind	Total
Retired Capacity	20,867	638	7,230	1,085	22	15	29,857

Revised Case Retirements

Revised Model Retirement Assumptions (retaining all units with less than 60 year life by 2028)							
	Coal	Deisel	Gas	Nuclear	Water	Wind	Total
Retired Capacity	8,593		1,027	1,085		15	10,720

Additional Capacity

Retirement Assumptions Delta							
	Coal	Deisel	Gas	Nuclear	Water	Wind	Total
Retired Capacity	12,274	638	6,203	-	22	-	19,137