

Overview of MRN-NEEM Results for the EIPC Future 1 (BAU) Sensitivity Cases

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Overview

- Using the EIPC stakeholder-approved input assumptions, CRA has completed MRN-NEEM modeling of Business-as-Usual (“BAU”) Future1, Sensitivities 4 (F1S4) through 16 (F1S16).
- BAU Sensitivity 3 (F1S3) served as the Base Case or starting point for each of these thirteen new Future 1 sensitivities.
 - *In F1S3, EPA regulations were modified to be more consistent with recently proposed regulations, and a few other selected changes were made from the original Future 1 Base Case.*
- In each of the new Future 1 sensitivities, transfer limits between NEEM regions are the same as those used in F1S3.

Detailed Summary Reports

- As before, a detailed summary of modeling results in excel-readable format was created for stakeholders to review for each sensitivity, including a Generation Report, Capacity Report and Transmission Report.
- In addition, a Summary Report is now included in the excel file for each sensitivity capturing the information previously presented in CRA summary presentations:
 - *El additions and retirements in 2015, 2020 and 2030 by capacity type.*
 - *El cumulative capacity additions through 2015, 2020 and 2030 by NEEM region in total and separately for new CCs and on-shore wind.*
 - *El cumulative coal retirements through 2015, 2020 and 2030 by NEEM region.*

Summary of Results – BAU Sensitivity 3 (from April 20)

- For BAU Sensitivity 3 (F1S3), the EI capacity expansion results are shown below (as previously issued on April 20).

BAU Sensitivity 3: New Builds and Retirements by Capacity Type for the Eastern Interconnection 2015, 2020 and 2030 (GW)

	2010 In- service	----- Additions -----			----- Retirements -----			2030 In- service
		2015	2020	2030	2015	2020	2030	
Coal	271.9	8.5	0.0	0.0	66.9	14.8	0.0	198.7
Nuclear	99.8	2.7	4.5	0.0	0.0	0.6	1.5	105.0
CC	132.7	30.7	18.1	26.2	5.7	0.0	0.0	202.0
CT	120.3	4.7	4.4	4.5	2.0	0.0	0.0	131.9
Steam Oil/Gas	74.5	0.0	0.0	0.0	37.1	0.6	0.4	36.4
Hydro	44.6	0.0	0.0	0.0	0.0	0.0	0.0	44.6
On-shore Wind	18.7	22.2	12.1	14.8	0.0	0.0	0.0	67.8
Off-shore Wind	0.0	0.5	0.0	1.1	0.0	0.0	0.0	1.6
Other Renewables	3.6	2.3	3.3	4.5	0.0	0.0	0.0	13.7
New HQ/Maritimes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other	17.1	0.0	0.0	0.0	0.0	0.0	0.0	17.1
Total	783.3	71.6	42.5	51.0	111.7	16.0	1.9	818.8
DR	33.1	-1.3	16.8	22.1				70.7

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Future 1: 2030 Installed EI Capacity by Type

- The total EI installed capacity in 2030 is shown below by type of capacity for each Future 1 sensitivity.

Installed 2030 EI Capacity by Type for each Future 1 Sensitivity (GW)

	Installed Capacity in 2030 in each Future 1 Sensitivity														
	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	
	Total 2010	Base Case	High Load	Low Load	High Gas	XHigh Gas	XLow Rnw\$	HiEE &RPS	High PHEV	Low Rnw\$	Delay EPA	LoEE &RPS	5YrDly EPA	NoPTC NoRPS	S15+ HiLoad
Coal	272	199	204	181	266	267	202	193	198	202	213	205	203	201	205
Nuclear	100	105	105	105	105	105	105	105	105	105	105	105	105	105	105
CC	133	202	305	147	158	158	186	170	214	190	190	229	200	210	318
CT	120	132	165	112	121	119	137	122	141	136	134	161	132	129	160
Steam Oil/Gas	75	36	47	9	23	22	38	19	38	37	31	43	34	34	47
Hydro	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
On-Shore Wind	19	68	79	55	92	93	120	72	69	108	66	54	68	38	38
Off-Shore Wind	0	2	2	2	2	2	4	2	2	4	2	2	2	2	2
Other Renewable	4	14	15	13	14	14	13	18	14	13	14	11	14	9	9
New HQ/Maritimes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
Total w/o DR	783	819	984	685	841	842	867	762	842	857	817	871	819	790	946
DR	33	71	85	58	71	71	71	109	73	71	71	32	71	71	85
Total w/DR	816	890	1069	743	912	913	937	871	916	927	887	904	890	861	1031
EI Demand 2030 (TWh)		3702	4473	3059	3702	3702	3702	3571	3781	3702	3702	3834	3702	3702	4473
Change from F1S3			21%	-17%	0%	0%	0%	-4%	2%	0%	0%	4%	0%	0%	21%

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Future 1: Change in 2030 EI Capacity from F1S3 Base Case

- The change in 2030 EI installed capacity from F1S3-Base Case is shown below for each sensitivity.

Change from F1S3-Base Case in Installed 2030 EI Capacity for each Future 1 Sensitivity (GW)

	Total S3	Increase in Installed Capacity in 2030 in each Future 1 Sensitivity from F1S3												
		S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16
Base Case	High Load	Low Load	High Gas	XHigh Gas	XLow Rnw\$	HiEE &RPS	High PHEV	Low Rnw\$	Delay EPA	LoEE &RPS	5YrDly EPA	NoPTC NoRPS	S15+ HiLoad	
Coal	199	6	(17)	67	69	4	(6)	(1)	4	15	6	4	2	6
Nuclear	105	0	0	0	0	0	0	0	0	0	0	0	0	0
CC	202	103	(55)	(44)	(44)	(16)	(32)	12	(12)	(12)	27	(2)	8	116
CT	132	33	(20)	(11)	(12)	5	(10)	10	4	2	29	0	(2)	28
Steam Oil/Gas	36	11	(27)	(13)	(14)	1	(17)	2	1	(5)	7	(2)	(2)	11
Hydro	45	0	0	0	0	0	0	0	0	0	0	0	0	0
On-Shore Wind	68	11	(13)	24	25	52	4	1	40	(2)	(14)	0	(30)	(30)
Off-Shore Wind	2	0	0	0	0	3	0	0	3	0	0	0	(0)	(0)
Other Renewable	14	1	(1)	0	0	(1)	4	0	(1)	0	(3)	0	(5)	(5)
New HQ/Maritimes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	17	0	0	0	0	0	0	0	0	0	0	0	0	0
Total w/o DR	819	165	(134)	22	23	48	(57)	24	38	(2)	53	0	(29)	127
DR	71	15	(12)	0	0	0	39	2	0	0	(39)	0	0	15
Total w/DR	890	180	(146)	22	23	48	(18)	26	38	(2)	14	0	(29)	142

Future 1 Sensitivity Observations for 2030 Relative to F1S3-Base Case

- High load (F1S4)
 - *Most of the additional capacity installed is comprised of gas-fired CCs and CTs.*
- Low load (F1S5)
 - *Coal plant and steam oil/gas retirements increase and fewer CCs, CTs and Wind are constructed.*
- High gas (F1S6),
 - *Coal retirements decrease and 32 GW of additional new coal capacity is constructed.*
 - *Fewer CCs and CTs are constructed, and more steam oil/gas retires*
 - *24 GW of additional wind is constructed* (because of the lower reserve value of wind, total installed EI capacity increases despite the same amount of demand in F1S6 as in F1S3).
- Extra High Gas (F1S7)
 - *2030 results are fairly similar to F1S6 as gas prices are the same by 2030.*
- Extra Low Renewable Costs (F1S8)
 - *52 GW of additional on-shore wind is installed.*
 - *3 GW of off-shore wind is installed in VACAR.*
 - *Other renewable builds are essentially unchanged.*

Future 1 Sensitivity Observations for 2030 Relative to F1S3-Base Case (cont.)

- Increased EE/DR and RPS (F1S9)
 - *Reduced CC and CT installations because of lower overall demand*
 - *EI wind and other renewable installations increase by 8 GW to meet the higher RPS.*
- High PHEV (F1S10)
 - *CCs and CTs are installed to meet the additional demand.*
- Low Renewable Costs (F1S11),
 - *Results are similar in direction to F1S8*
- New EPA Regulations Delayed (F1S12)
 - *Coal plant retirements decrease by 15 GW, offset by increased steam oil/gas retirements and reduced CC installations.*
- Reduced EE/DR and RPS (F1S13)
 - *Increased CC and CT installations in response to higher demand*
 - *Reduced wind builds in response to lower RPS*

Future 1 Sensitivity Observations for 2030 Relative to F1S3-Base Case (cont.)

- 5-Year Delay in New EPA Regulations (F1S14)
 - *There is a modest (4GW) reduction in EI coal retirements.*
- PTC Expires/No RPS (F1S15)
 - *EI on-shore wind construction is reduced substantially (30 GW).*
 - *Only forced on-shore wind installations of 23 GW take place.*
 - *Total installed capacity decreases given the reduction in installed wind (wind has a lower reserve value).*
- PTC Expires/No RPS/High Load (F1S16),
 - *Results are similar to F1S15 for Wind*
 - *CC and CT capacity is constructed to meet the additional demand.*

Summary of Results – Wind Builds by NEEM Region

- New off-shore wind builds are shown below (*note that there are 23 GW of forced EI wind builds*).

Cumulative New On-shore Wind Capacity Through 2030 by EI NEEM Region for Each Future 1 Sensitivity (GW)

	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16
	Base	High	Low	High	XHigh	XLow	HiEE	High	Low	Delay	LoEE	5YrDly	NoPTC	S15+
	Case	Load	Load	Gas	Gas	Rnw\$	&RPS	PHEV	Rnw\$	EPA	&RPS	EPA	NoRPS	HiLoad
ENT	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IESO	2	2	2	2	2	2	2	2	2	2	2	2	2	2
MAPP_CA	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MAPP_US	1	2	1	1	1	1	1	1	1	1	1	1	0	0
MISO_IN	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MISO_MI	3	4	2	3	3	3	4	3	3	3	2	3	2	2
MISO_MO-IL	0	0	0	0	0	3	0	0	0	0	0	0	0	0
MISO_W	9	12	6	13	15	30	12	9	23	9	5	9	3	3
MISO_WUMS	1	1	1	1	1	1	1	1	1	1	1	1	1	1
NE	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NEISO	5	5	4	5	5	5	5	5	5	5	5	5	0	0
NonRTO_Midwest	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NYISO_A-F	4	7	3	3	3	4	5	4	4	4	3	4	3	3
NYISO_G-I	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NYISO_J-K	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PJM_E	1	1	1	1	1	1	1	1	1	1	1	1	1	1
PJM_ROM	7	7	1	7	7	1	1	7	1	5	1	7	0	0
PJM_ROR	9	10	9	12	12	24	10	9	23	9	9	9	8	8
SOCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPP_N	0	0	0	0	0	0	2	0	0	0	0	0	0	0
SPP_S	3	5	2	20	20	19	3	3	20	3	1	4	1	1
TVA	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VACAR	4	4	4	4	4	4	4	4	4	4	4	4	0	0
	49	60	36	73	75	101	54	50	89	47	35	49	23	23

Additional wind, if any, mostly built in MISO_W, PJM_ROR, and SPP_S.

Summary of Results – Coal Retirements by NEEM Region

- Future 1 EI coal retirements through 2030.

Coal Retirements Through 2030 by EI NEEM Region for each Future 1 Sensitivity (GW)

	Existing	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16
	2010	Base Case	High Load	Low Load	High Gas	XHigh Gas	XLow Rnw\$	HiEE &RPS	High PHEV	Low Rnw\$	Delay EPA	LoEE &RPS	5YrDly EPA	NoPTC NoRPS	S15+ HiLoad
ENT	8	1	1	1	0	0	1	1	1	1	1	1	1	1	1
FRCC	9	1	2	1	1	1	1	1	1	1	1	1	1	1	2
IESO	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
MAPP_CA	2	1	1	1	0	0	1	1	1	1	1	1	1	1	1
MAPP_US	5	1	1	1	0	0	1	1	1	1	1	1	1	1	0
MISO_IN	15	1	1	2	0	0	1	1	1	1	1	1	1	1	1
MISO_MI	11	4	4	6	2	2	4	5	4	4	2	4	4	4	5
MISO_MO-IL	14	2	2	4	1	1	2	2	2	2	1	2	2	2	2
MISO_W	13	3	3	3	3	3	3	3	3	3	3	3	3	3	2
MISO_WUMS	8	3	4	3	1	1	3	4	3	2	2	3	3	3	4
NE	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NEISO	3	3	3	3	1	1	3	3	3	3	3	3	3	3	3
NonRTO_Midwest	11	1	1	3	1	1	1	1	1	1	1	1	1	1	1
NYISO_A-F	2	2	2	2	1	1	2	2	2	2	2	2	2	2	2
NYISO_G-I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NYISO_J-K	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PJM_E	4	4	3	4	2	2	3	3	3	3	4	3	4	3	3
PJM_ROM	16	8	7	8	5	4	8	8	8	8	9	7	8	8	7
PJM_ROR	60	20	16	26	11	10	21	22	19	20	13	15	18	19	16
SOCO	25	9	9	11	5	5	9	10	9	9	8	9	9	9	9
SPP_N	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPP_S	13	2	2	2	0	0	1	2	2	1	0	2	1	1	2
TVA	15	5	4	5	2	2	4	5	5	4	3	4	4	5	4
VACAR	20	6	6	7	3	3	5	6	6	5	4	5	5	6	6
	272	82	76	99	47	44	81	88	82	80	67	76	78	80	76

Retirements change relatively evenly by region across sensitivities (all coal is force-retired in the IESO).

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Summary of Results – New CCs by NEEM Region

- Future 1 new CC builds by EI region are shown below.

Cumulative New CCs through 2030 by EI NEEM Region for each Future 1 Sensitivity (GW)

	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16
	Base	High	Low	High	XHigh	XLow	HiEE	High	Low	Delay	LoEE	5YrDly	NoPTC	S15+
	Case	Load	Load	Gas	Gas	Rnw\$	&RPS	PHEV	Rnw\$	EPA	&RPS	EPA	NoRPS	HiLoad
ENT	3	8	0	0	0	2	2	3	2	2	4	2	3	8
FRCC	13	24	4	6	6	12	10	15	13	13	18	13	13	24
IESO	1	2	1	1	1	1	1	1	1	1	1	1	1	2
MAPP_CA	2	4	0	0	0	1	1	2	2	2	3	2	2	4
MAPP_US	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MISO_IN	4	13	0	0	0	1	0	5	1	0	6	3	6	14
MISO_MI	0	1	0	0	0	0	0	0	0	0	0	0	0	2
MISO_MO-IL	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MISO_W	0	0	0	0	0	0	0	0	0	0	0	0	0	2
MISO_WUMS	4	6	0	0	0	1	1	3	2	1	4	3	4	6
NE	0	1	0	0	0	0	0	0	0	0	0	0	0	1
NEISO	2	2	2	2	2	2	2	2	2	2	2	2	2	2
NonRTO_Midwest	1	2	0	0	0	1	1	1	1	0	1	1	1	2
NYISO_A-F	1	1	1	1	1	1	1	1	1	1	1	1	1	1
NYISO_G-I	1	4	0	1	1	1	0	2	1	1	2	1	2	5
NYISO_J-K	1	2	1	1	1	1	1	1	1	1	1	1	1	2
PJM_E	5	5	5	5	5	5	5	5	5	5	5	5	5	5
PJM_ROM	2	2	2	2	2	2	2	2	2	2	2	2	2	3
PJM_ROR	8	34	3	3	3	9	3	14	7	8	20	9	10	37
SOCO	8	20	5	5	5	5	6	9	7	8	10	8	8	20
SPP_N	2	6	0	0	0	0	1	2	1	2	2	2	1	6
SPP_S	2	8	0	0	0	0	0	3	0	2	4	2	4	10
TVA	4	9	1	1	1	3	3	4	4	3	5	4	5	9
VACAR	11	19	4	5	6	11	5	11	11	9	12	10	13	22
	75	173	29	34	35	59	45	87	62	63	101	72	82	186

Additional CCs, if any, mostly in FRCC, PJM_ROR, SOCO and VACAR. New MISO CCs continue to be in WUMS and IN.