Overview of Results for EIPC Future 6, 7 and 8 Sensitivities

August 18, 2011

CRA Charles River Associates

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Overview

- Using the EIPC stakeholder-approved input assumptions, CRA has completed modeling of:
  - *Future 6 "National RPS – State/Regional Implementation" for:*
    - *F6 Sensitivities: F6S2 through F6S10 (F6S5 was used elsewhere, F6S8 is reserved) using Hard Limits*
  - *Future 7 "Nuclear Resurgence" for:*
    - *F7 Sensitivities: F7S2, F7S3 and F7S4*
  - *Future 8 "Combined Federal Climate and Energy Policy" for:*
    - *F8 Sensitivities: F8S3 and F8S4*
- Of the 80 total runs, 76 have now been completed.

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Future 6 (National RPS – Regional Implementation) Results

- Total EI capacity in 2030 is shown below by type for Future 6 in comparison to the BAU.
  - F6S10 (Hard limits) builds are close to F6S1 (25%). Hard limits are used in F6S2 through F6S10.
  - Relative to Future 5, more off-shore wind and more other renewables are installed.
  - Clean Energy Standard (F6S4) of 70% by 2030 increases coal retirements, reduces wind builds and increases CC and nuclear builds relative to F6S10.

Installed 2030 EI Capacity by Type: BAU vs. Future 6 (GW)

		Installed Capacity in 2030									
		F1S3	F6B	F6S1	F6S2	F6S3	F6S4	F6S6	F6S7	F6S9	F6S10
	Total 2010	BAU Base	Reg RPS	25% Soft	High Load	High Gas	Fed CES	HiCN Impt	Incr PHEV	OffSh Wind	Hard Limit
Coal	272	199	178	176	198	221	81	178	178	178	178
Nuclear	100	105	105	105	105	105	123	105	105	105	105
CC	133	202	157	159	209	147	246	156	161	157	157
CT	120	132	134	134	176	123	147	135	142	133	134
Steam Oil/Gas	75	36	38	38	48	22	42	37	39	37	38
Hydro	45	45	52	52	52	52	53	52	52	52	52
On-Shore Wind	19	68	160	159	187	160	138	158	164	154	159
Off-Shore Wind	0	2	39	39	51	39	2	39	39	51	38
Other Renewable	4	14	37	37	57	36	13	37	38	36	37
New HQ/Maritimes	0	0	0	1	1	1	1	1	1	0	1
Other	17	17	17	17	17	17	17	17	17	17	17
Total w/o DR	783	819	916	917	1,100	922	863	915	935	921	916
DR	33	71	71	71	85	71	71	71	76	71	71
Total w/DR	816	890	987	987	1,186	993	933	985	1,011	991	987

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Future 6 Results (cont.)

- EI new capacity through 2030 is shown below by NEEM region for Future 6 in comparison to the BAU.

2030 EI New Builds by Region: BAU vs. Future 6 (GW)

	Cum New Builds in 2030									
	F1S3	F6B	F6S1	F6S2	F6S3	F6S4	F6S6	F6S7	F6S9	F6S10
	BAU Base	Reg RPS	25% Soft	High Load	High Gas	Fed CES	HiCN Impt	Incr PHEV	OffSh Wind	Hard Limit
ENT	4	2	2	8	2	7	2	3	2	2
FRCC	16	9	9	27	13	13	9	11	9	9
IESO	5	5	5	5	5	5	5	5	5	5
MAPP_CA	2	5	5	6	5	5	5	5	5	5
MAPP_US	2	8	8	12	8	10	7	6	7	7
MISO_IN	5	1	1	10	1	23	1	1	1	1
MISO_MI	3	3	3	3	3	7	3	3	3	3
MISO_MO-IL	2	3	3	3	3	3	3	3	3	3
MISO_W	9	17	17	26	16	20	17	20	18	18
MISO_WUMS	10	14	16	30	10	21	15	18	14	14
NE	1	1	3	5	1	9	3	3	3	3
NEISO	9	9	8	11	8	8	8	9	9	8
NonRTO_Mid	1	1	1	4	1	4	1	2	1	1
NYISO_A-F	4	4	4	5	4	4	4	4	4	4
NYISO_G-I	1	0	0	4	0	0	0	0	0	0
NYISO_J-K	3	3	3	4	3	3	3	4	6	3
PJM_E	7	16	16	18	16	7	16	18	16	16
PJM_ROM	12	14	14	17	14	11	14	14	14	14
PJM_ROR	20	61	61	77	61	47	61	62	62	61
SOCO	10	14	14	20	15	13	14	14	14	14
SPP_N	3	14	5	21	10	9	11	13	11	11
SPP_S	8	26	32	34	29	43	26	26	26	26
TVA	8	10	10	18	9	15	10	11	10	10
VACAR	20	48	49	62	49	29	49	49	49	48
	165	287	288	429	286	318	285	301	292	286

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Future 6 Results (cont.)

- EI new CC and on-shore wind builds through 2030 are shown below by NEEM region for Future 5.
  - Wind builds by region are relatively consistent across the cases in this regional RPS future.

2030 EI New CC and On-Shore Wind Builds by Region: BAU vs. Future 6 (GW)

	Cum New CCs in 2030										Cum New On-Sh Wind in 2030									
	F1S3	F6B	F6S1	F6S2	F6S3	F6S4	F6S6	F6S7	F6S9	F6S10	F1S3	F6B	F6S1	F6S2	F6S3	F6S4	F6S6	F6S7	F6S9	F6S10
	BAU Base	Reg RPS	25% Soft	High Load	High Gas	Fed CES	HiCN Impt	Incr PHEV	OffSh Wind	Hard Limit	BAU Base	Reg RPS	25% Soft	High Load	High Gas	Fed CES	HiCN Impt	Incr PHEV	OffSh Wind	Hard Limit
ENT	3	1	1	7	0	4	1	2	1	1	0	0	0	0	0	0	0	0	0	0
FRCC	13	4	4	12	2	2	4	6	4	4	0	0	0	0	0	0	0	0	0	0
IESO	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
MAPP_CA	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MAPP_US	0	0	0	0	0	0	0	0	0	0	1	7	7	11	8	10	6	6	6	6
MISO_IN	4	0	0	9	0	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MISO_MI	0	0	0	0	0	4	0	0	0	0	3	2	2	3	2	2	2	3	2	2
MISO_MO-IL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
MISO_W	0	0	0	0	0	0	0	0	0	0	9	17	17	26	15	20	16	19	18	18
MISO_WUMS	4	0	2	5	0	7	0	1	0	0	1	1	1	1	1	1	1	1	1	1
NE	0	0	0	0	0	0	0	0	0	0	0	0	3	4	0	8	2	3	2	2
NEISO	2	2	2	2	2	2	2	2	2	2	5	5	5	5	5	5	4	5	0	4
NonRTO_Mid	1	0	0	2	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0
NYISO_A-F	1	1	1	1	1	1	1	1	1	1	4	3	3	4	3	3	3	3	3	3
NYISO_G-I	1	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NYISO_J-K	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
PJM_E	5	5	5	5	5	5	5	5	5	5	1	1	1	4	1	1	1	4	1	1
PJM_ROM	2	2	2	2	2	7	2	2	2	2	7	7	7	7	7	1	7	7	7	7
PJM_ROR	8	3	3	6	3	23	3	3	3	3	9	54	54	54	54	21	54	54	53	54
SOCO	8	5	5	9	5	9	5	5	5	5	0	0	0	0	0	0	0	0	0	0
SPP_N	2	0	0	2	0	3	0	0	0	0	0	13	4	10	10	5	11	11	11	11
SPP_S	2	0	0	0	0	4	0	0	0	0	3	24	30	31	27	35	24	24	24	24
TVA	4	1	1	2	1	9	1	1	1	1	0	0	0	0	0	0	0	0	0	0
VACAR	11	3	3	6	2	11	3	3	3	3	4	4	4	4	4	4	4	4	4	4
	75	30	31	76	26	118	30	34	30	30	49	141	141	168	141	119	139	146	136	141

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Future 7 (Nuclear Resurgence) Results

- Total EI capacity in 2030 is shown below by type for Future 7 in comparison to the BAU.
  - Nuclear builds increase when carbon prices are applied in the electric sector (F7S3).
  - SMR assumptions do not result in additional economic nuclear builds by 2030 (F7S4). There is a small increase after 2030.

Installed 2030 EI Capacity by Type: BAU vs. Future 7 (GW)

		Installed Capacity in 2030					
		F1S3	F7B	F7S1	F7S2	F7S3	F7S4
	Total 2010	BAU Base	Nuk Res	25% Soft	High Load	CO2 Price	SMR Nuk
Coal	272	199	199	197	206	63	199
Nuclear	100	105	129	129	129	191	129
CC	133	202	174	172	280	265	174
CT	120	132	134	137	162	118	134
Steam Oil/Gas	75	36	34	35	47	30	34
Hydro	45	45	47	47	47	52	47
On-Shore Wind	19	68	68	68	77	116	68
Off-Shore Wind	0	2	2	2	2	2	2
Other Renewable	4	14	14	14	15	14	14
New HQ/Maritimes	0	0	0	0	1	0	0
Other	17	17	17	17	17	17	17
Total w/o DR	783	819	818	818	981	866	818
DR	33	71	71	71	85	71	71
Total w/DR	816	890	889	889	1,067	936	889

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Future 7 Results (cont.)

- EI new build capacity through 2030 is shown below by region for Future 7.

2030 EI New Builds by Region: Future 7 (GW)

	Cum New Builds in 2030						Cum New CCs in 2030						Cum New On-Sh Wind in 2030					
	F1S3	F7B	F7S1	F7S2	F7S3	F7S4	F1S3	F7B	F7S1	F7S2	F7S3	F7S4	F1S3	F7B	F7S1	F7S2	F7S3	F7S4
	BAU Base	Nuk Res	25% Soft	High Load	CO2 Price	SMR Nuk	BAU Base	Nuk Res	25% Soft	High Load	CO2 Price	SMR Nuk	BAU Base	Nuk Res	25% Soft	High Load	CO2 Price	SMR Nuk
ENT	4	3	3	10	14	3	3	2	2	8	9	2	0	0	0	0	0	0
FRCC	16	14	14	25	29	14	13	7	6	18	5	6	0	0	0	0	0	0
IESO	5	6	6	6	6	6	1	1	1	1	1	1	2	2	2	2	2	2
MAPP_CA	2	3	3	4	5	3	2	0	0	2	0	0	0	0	0	0	0	0
MAPP_US	2	2	2	3	3	2	0	0	0	0	1	0	1	1	1	2	1	1
MISO_IN	5	2	1	13	21	2	4	1	0	12	20	1	0	0	0	0	0	0
MISO_MI	3	4	4	5	8	4	0	0	0	0	1	0	3	3	3	4	2	3
MISO_MO-IL	2	3	3	3	7	3	0	0	0	0	5	0	0	0	0	0	0	0
MISO_W	9	9	9	12	37	9	0	0	0	0	3	0	9	9	9	12	34	9
MISO_WUMS	10	10	12	25	10	10	4	2	3	5	8	2	1	1	1	1	1	1
NE	1	1	3	1	4	1	0	0	0	0	3	0	0	0	2	0	0	0
NEISO	9	9	9	11	9	9	2	2	2	2	2	2	5	5	5	5	5	5
NonRTO_Mid	1	1	1	4	8	1	1	1	1	3	4	1	0	0	0	0	0	0
NYISO_A-F	4	5	4	7	5	4	1	1	1	1	1	1	4	4	3	6	4	3
NYISO_G-I	1	1	0	5	2	1	1	1	0	4	1	1	0	0	0	0	0	0
NYISO_J-K	3	3	4	5	3	3	1	1	1	2	3	1	0	0	0	0	0	0
PJM_E	7	8	9	9	8	8	5	5	5	5	5	5	1	1	1	1	1	1
PJM_ROM	12	14	15	16	10	14	2	2	2	2	2	2	7	6	7	7	1	6
PJM_ROR	20	20	19	47	55	20	8	4	3	30	24	4	9	9	9	9	21	9
SOCO	10	11	11	22	28	11	8	9	9	19	12	9	0	0	0	0	0	0
SPP_N	3	2	1	8	14	2	2	1	0	5	4	1	0	0	0	0	7	0
SPP_S	8	8	7	14	27	8	2	2	3	7	7	2	3	5	3	5	13	5
TVA	8	9	9	18	18	9	4	3	2	8	9	3	0	0	0	0	0	0
VACAR	20	19	19	32	32	19	11	5	4	14	11	5	4	4	4	4	4	4
	165	169	170	304	364	169	75	47	45	148	141	47	49	49	49	59	97	49

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Future 8 (Combined Federal Climate and Energy Policy) Results

- Total EI capacity in 2030 is shown below by type for Future 8 in comparison to the BAU.
  - F8S1 (OL75) was used as the basis for the hard limits for F8S3 and F8S4.
  - In comparison to F8S1, both the Low Renewable Cost (F8S3) and High RPS (F8S4) cases increase wind builds in place of CCs.

Installed 2030 EI Capacity by Type: BAU vs. Future 7 (GW)

		Installed Capacity in 2030					
		F1S3	F8B	F8S1	F8S2	F8S3	F8S4
	Total 2010	BAU Base	CO2+ RPS	75% Soft	25% Soft	Low Rnw$	Hi RPS
Coal	272	199	17	17	18	18	18
Nuclear	100	105	137	135	133	139	136
CC	133	202	210	199	186	181	190
CT	120	132	61	64	71	75	69
Steam Oil/Gas	75	36	9	4	4	4	4
Hydro	45	45	49	49	52	51	50
On-Shore Wind	19	68	245	263	287	294	303
Off-Shore Wind	0	2	2	2	2	3	2
Other Renewable	4	14	12	12	13	12	12
New HQ/Maritimes	0	0	0	0	3	5	5
Other	17	17	17	17	17	17	17
Total w/o DR	783	819	759	762	786	799	805
DR	33	71	152	152	152	152	152
Total w/DR	816	890	912	915	938	951	958

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Future 8 Results (cont.)

- EI capacity in 2030 is shown below by region for Future 8.
  - *In comparison to F8S1, the increased wind builds in F8S3 and F8S4 are largely in MISO.*

2030 EI Capacity by Region: Future 8 (GW)

	Cum New Builds in 2030						Cum New CCs in 2030						Cum New On-Sh Wind in 2030					
	F1S3	F8B	F8S1	F8S2	F8S3	F8S4	F1S3	F8B	F8S1	F8S2	F8S3	F8S4	F1S3	F8B	F8S1	F8S2	F8S3	F8S4
	BAU Base	CO2+ RPS	75% Soft	25% Soft	Low Rnw$	Hi RPS	BAU Base	CO2+ RPS	75% Soft	25% Soft	Low Rnw$	Hi RPS	BAU Base	CO2+ RPS	75% Soft	25% Soft	Low Rnw$	Hi RPS
ENT	4	7	5	3	6	4	3	6	4	2	2	3	0	0	0	0	2	0
FRCC	16	31	31	31	31	31	13	11	10	10	11	11	0	0	0	0	0	0
IESO	5	5	5	5	5	5	1	1	1	1	1	1	2	2	2	2	2	2
MAPP_CA	2	3	3	5	4	4	2	1	1	1	0	0	0	0	0	0	0	0
MAPP_US	2	6	10	12	5	8	0	0	0	0	0	0	1	6	10	11	5	8
MISO_IN	5	55	47	12	42	58	4	15	17	11	10	14	0	39	29	0	31	43
MISO_MI	3	6	3	2	3	4	0	3	1	0	0	1	3	3	3	2	3	3
MISO_MO-IL	2	28	8	8	14	22	0	0	0	0	0	0	0	26	6	6	11	19
MISO_W	9	27	61	96	71	69	0	0	0	0	0	0	9	27	61	96	71	69
MISO_WUMS	10	15	8	12	7	13	4	4	5	10	5	5	1	9	1	1	1	8
NE	1	13	15	18	19	17	0	0	0	0	0	0	0	12	15	18	19	16
NEISO	9	9	9	9	9	9	2	2	2	2	2	2	5	5	5	5	5	5
NonRTO_Mid	1	5	5	5	6	5	1	4	5	4	3	4	0	0	0	0	0	0
NYISO_A-F	4	6	7	4	9	4	1	1	1	1	1	1	4	5	6	3	8	3
NYISO_G-I	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
NYISO_J-K	3	1	1	1	2	1	1	1	1	1	1	1	0	0	0	0	0	0
PJM_E	7	7	7	7	7	7	5	5	5	5	5	5	1	1	1	1	1	1
PJM_ROM	12	6	6	7	6	6	2	2	2	2	2	2	7	1	1	1	1	1
PJM_ROR	20	55	37	25	30	38	8	26	21	13	13	16	9	26	13	9	13	19
SOCO	10	22	21	15	20	20	8	10	10	10	11	10	0	0	0	0	0	0
SPP_N	3	27	42	67	53	42	2	0	0	0	0	0	0	26	41	66	52	42
SPP_S	8	35	47	45	47	42	2	0	0	0	0	0	3	33	46	43	45	40
TVA	8	8	8	8	8	7	4	6	6	4	4	6	0	0	0	0	0	0
VACAR	20	25	23	22	25	24	11	12	11	9	11	11	4	4	4	4	4	4
	165	404	411	421	429	443	75	109	101	86	81	92	49	226	244	268	275	284

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2030 Energy Source by Future (Hard Limits, if Run)

- EI generation as a percent of demand, EI energy demand , and EI CO_2 emissions are shown below for 2030 for each Future.
  - Results for the Base transfer limits are shown for F1 (BAU), F4 and F7
  - Hard transfer limit results are shown for F2, F3, F5 and F6. F8S1 (OL75) is shown for F8.
    - BAU is F1S3. Hard limits cases are F2S11, F3S12, F5S10, and F6S10.

2030 EI Generation as Percent of EI Demand for Six Key Capacity Types, EI Demand, and EI CO_2 Emissions

	BAU	F2 Hard	F3 Hard	F4B	F5 Hard	F6 Hard	F7B	F8 OL75
CC	25%	26%	37%	16%	15%	13%	19%	26%
Coal	38%	1%	2%	41%	32%	33%	39%	1%
Nuclear	22%	31%	32%	27%	23%	23%	27%	35%
On-Shore Wind	5%	30%	18%	5%	20%	13%	5%	28%
Off-Shore Wind	0%	0%	0%	0%	0%	4%	0%	0%
Hydro	5%	7%	7%	7%	6%	6%	6%	7%
Total	96%	96%	96%	96%	96%	91%	96%	96%
Demand (TWh)	3702	3248	3248	3008	3609	3609	3700	3008
Change from BAU		*-12%*	*-12%*	*-19%*	*-3%*	*-3%*	*0%*	*-19%*
CO_2 (Mil MetricTons)	1716	296	408	1367	1310	1316	1650	268
Change from BAU		*-83%*	*-76%*	*-20%*	*-24%*	*-23%*	*-4%*	*-84%*

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Next Steps

1. SSC specifies reserved sensitivities.
2. The reserved sensitivities are run.