

CARIS RESULTS - BASE CASE

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Agenda

Review Input Assumptions

- *External representation*
- *Input discussion*

- ◆ Base Case Congestion Results
- ◆ Discussion
- ◆ Next Steps

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- ◆ Full Representation

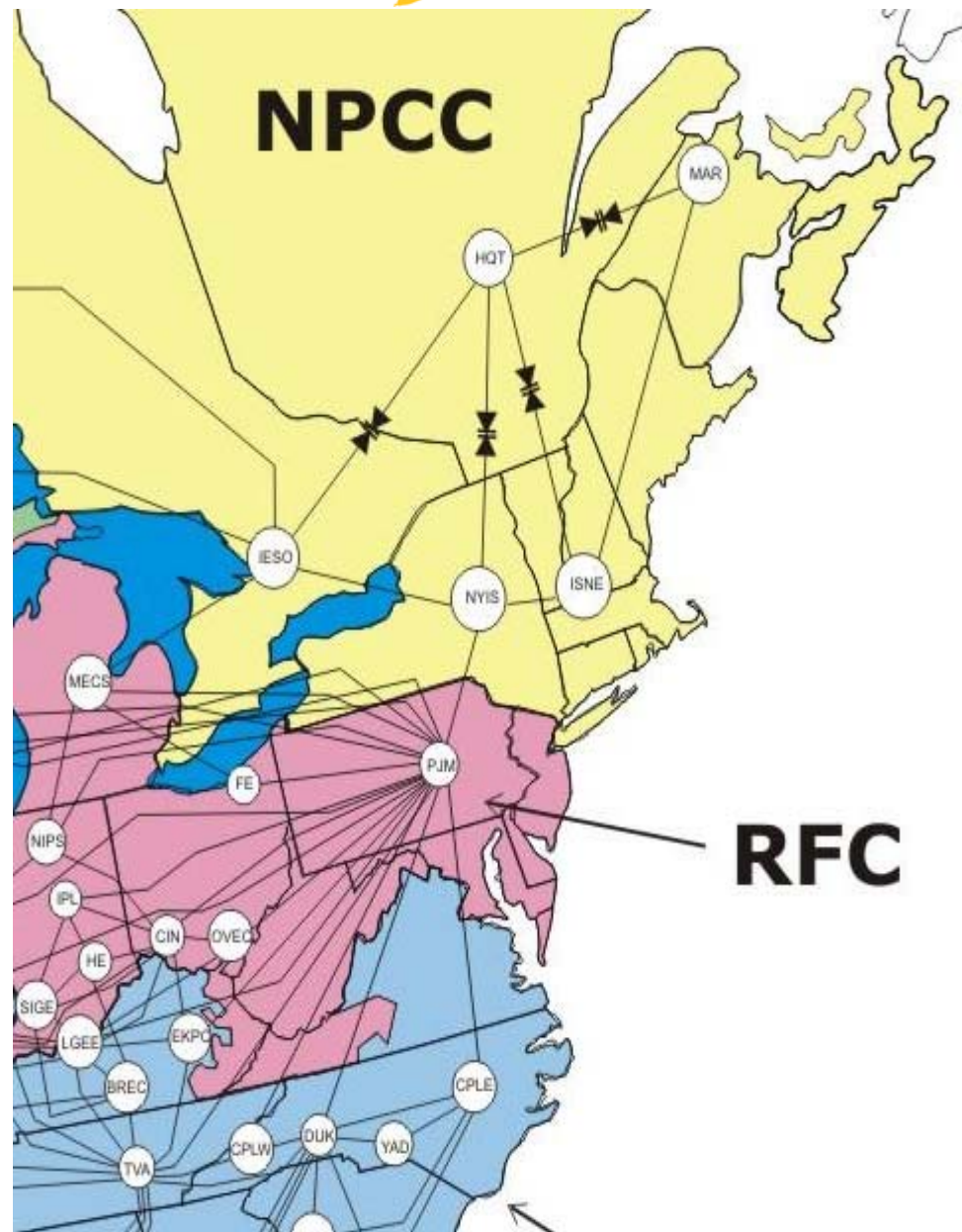
- NYISO
- NEISO
- IESO
- PJM
 - PJM Classic
 - AP, AEP, CE, DLCO, DAY and VP

- ◆ Proxy Bus

- HQ to NYISO & ISONE

- ◆ Transmission Only

- MECS, FE, SPP, MAR, NIPS, OVEC, TVA
- FRCC, SERC, ERCOT, WECC



Input Discussion

- ◆ DC lines
- ◆ Athens SPS
- ◆ Open dispatch with hurdle rates
- ◆ Fuel switching

CARIS Metrics Historical & Projected - Preliminary Results (Constrained cases)

YEAR	CARIS Metrics ⁽¹⁾ m\$				GWh ⁽²⁾		
	Load Payment	Generator Payment	Production Cost ⁽³⁾	Congestion	Demand	Generation	Interchange
2004	10,059	8,615	N/A	831	160,211	147,171	13,040
2005	15,314	13,153	N/A	1,382	167,208	153,265	13,943
2006	11,969	10,241	N/A	1,541	162,237	148,359	13,878
2007	12,831	10,840	N/A	1,451	167,341	150,407	16,934
2008	15,485	12,178	N/A	2,540	165,613	144,619	20,994
	PROJECTED				PROJECTED		
2009	8,161	7,118	3,847	520	168,128	151,830	16,299
2010	10,415	8,944	4,894	851	169,747	152,358	17,389
2011	10,769	9,280	5,060	838	171,008	153,627	17,381
2012	11,316	9,695	5,305	854	171,927	153,557	18,370
2013	12,376	11,078	5,932	998	173,156	161,193	11,963
2014	13,108	11,629	6,249	1,150	174,800	162,262	12,538
2015	14,528	13,099	7,179	778	176,107	164,794	11,314
2016	15,620	14,097	7,663	819	178,250	167,197	11,053
2017	16,475	14,883	8,076	859	179,283	168,470	10,813
2018	16,869	14,745	8,086	809	180,427	163,677	16,750

(1) Source: Annual Market Congestion Report

(2) Source: NYISO Load & Capacity Data Reports GoldBook 2005-2009

(3) Market Reports record Bid Production Cost, which is a negative number because of high number of negative market bids

Historical Data Source: PROBE DAM quarterly reports; DAM data include Bid Load, Virtual bidding & Transmission planned outages

Projected Data Source: NYISO CARIS Base Cases (does not include Virtuals and Transmission outages)

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Projected - Zonal Demand (GWh)

Area	Demand GWh									
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
West	16,011	16,143	16,189	16,211	16,287	16,375	16,436	16,532	16,615	16,689
Genessee	10,067	10,162	10,154	10,157	10,210	10,323	10,410	10,519	10,615	10,703
Central	16,881	16,975	17,039	17,035	17,102	17,219	17,311	17,418	17,464	17,507
North	7,014	7,102	7,147	7,153	7,178	7,192	7,176	7,185	7,171	7,187
Mohawk Valley	8,020	8,066	8,109	8,117	8,127	8,171	8,202	8,228	8,238	8,244
Capital	11,907	11,919	12,042	12,074	12,160	12,257	12,355	12,487	12,621	12,757
Hudson Valley	11,007	11,146	11,263	11,302	11,382	11,496	11,496	11,656	11,757	11,827
Millwood	2,748	2,786	2,817	2,830	2,871	2,884	2,903	2,928	2,954	2,985
Dunwoodie	6,478	6,541	6,572	6,564	6,593	6,586	6,595	6,607	6,638	6,680
NYCity	54,987	55,905	56,661	57,503	58,358	59,430	60,353	61,628	62,083	62,569
Long Island	23,008	23,002	23,015	22,981	22,888	22,866	22,870	23,062	23,127	23,278
Total	168,128	169,747	171,008	171,927	173,156	174,800	176,107	178,250	179,283	180,427

Projected Demand Data Source: NYISO CARIS Base Cases

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Projected - Zonal Generations (GWh)

Area	Generator GWh									
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
West	25,888	26,567	26,548	26,639	26,789	26,784	27,003	27,073	27,048	26,846
Genessee	4,938	5,215	5,217	5,253	5,291	5,272	5,517	5,335	5,326	5,293
Central	35,315	35,516	35,646	35,825	36,150	36,203	36,287	30,435	30,374	30,228
North	10,555	10,839	10,865	10,910	10,927	10,952	11,033	11,076	11,058	10,791
Mohawk Valley	3,831	4,271	4,295	4,327	4,439	4,478	4,673	4,711	4,738	4,637
Capital	14,769	17,969	18,361	18,243	20,199	20,312	21,249	21,502	21,454	21,303
Hudson Valley	5,048	4,499	4,690	4,761	5,432	5,475	6,546	6,896	7,184	6,554
Millwood	17,085	17,085	17,085	17,136	17,085	17,085	17,086	17,136	17,086	17,086
Dunwoodie	6	6	6	6	6	6	6	6	6	6
NYCity	22,814	20,382	20,226	19,933	22,153	22,763	25,757	26,527	27,066	25,713
Long Island	11,580	10,011	10,689	10,516	12,728	12,932	15,836	16,499	17,132	15,219
Total	151,830	152,358	153,627	153,557	161,193	162,262	164,794	167,197	168,470	163,677

- ◆ Higher ISONE imports in 2013-2018 compared to 2009-2012
- ◆ Higher IESO imports in 2009
 - *Investigating both*

Projected Generation Data Source: NYISO CARIS Base Cases (does not include Virtual Bidding and Transmission outages)

Projected Production Cost

Generator Production Cost m\$										
Area	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
West	363	440	451	470	489	506	541	557	571	569
Genessee	64	86	87	91	97	98	106	110	114	116
Central	739	904	923	976	1,019	1,055	1,021	1,064	1,095	1,157
North	92	129	133	140	143	149	159	166	172	178
Mohawk Valley	41	90	98	107	115	123	152	159	167	165
Capital	513	888	925	962	1,088	1,136	1,253	1,317	1,375	1,418
Hudson Valley	179	178	195	209	264	278	379	423	467	429
Millwood	204	200	198	204	209	214	229	235	240	248
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NYCity	1,125	1,355	1,370	1,442	1,630	1,767	2,138	2,320	2,455	2,511
Long Island	526	624	680	704	876	922	1,200	1,312	1,419	1,296
Total	3,847	4,894	5,060	5,305	5,932	6,249	7,179	7,663	8,076	8,086

Projected Production Cost Source: NYISO CARIS Base Cases (does not include Virtuals and Transmission outages)

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Zonal Load Payment Projected - Preliminary Results

Load LBMP Payment m\$										
Area	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
West	713	908	937	984	1,049	1,094	1,202	1,276	1,339	1,346
Genessee	457	570	587	614	654	685	766	816	854	854
Central	768	957	991	1,036	1,130	1,182	1,340	1,432	1,507	1,543
North	316	397	413	430	466	486	550	584	612	624
Mohawk Valley	367	457	474	496	540	564	642	685	719	736
Capital	544	684	713	747	869	908	1,001	1,074	1,136	1,197
Hudson Valley	530	664	701	732	814	856	943	1,020	1,079	1,112
Millwood	134	169	180	188	209	219	243	260	276	285
Dunwoodie	314	397	417	434	477	497	549	585	617	634
NYCity	2,891	3,775	3,869	4,111	4,508	4,889	5,388	5,847	6,191	6,332
Long Island	1,126	1,436	1,488	1,544	1,660	1,729	1,904	2,041	2,145	2,206
Total	8,161	10,415	10,769	11,316	12,376	13,108	14,528	15,620	16,475	16,869

- ◆ Higher ISONE imports in 2013-2018 compared to 2009-2012
- ◆ Higher IESO imports in 2009
 - *Investigating both*

Projected Demand Data Source: NYISO CARIS Base Cases

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Zonal Generator Payment (million \$) Projected - Preliminary Results

Area	Generator LBMP Payment									
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
West	1,157	1,482	1,522	1,596	1,695	1,755	1,952	2,061	2,129	2,111
Genessee	224	291	300	316	338	349	391	413	429	420
Central	1,590	1,982	2,054	2,152	2,356	2,452	2,311	2,461	2,581	2,621
North	476	606	627	656	710	740	845	899	943	940
Mohawk Valley	175	239	249	262	292	306	364	390	412	414
Capital	666	1,023	1,074	1,117	1,413	1,472	1,683	1,798	1,885	1,930
Hudson Valley	252	275	301	320	406	426	561	629	686	647
Millwood	803	1,004	1,052	1,092	1,194	1,246	1,375	1,462	1,532	1,558
Dunwoodie	0	0	0	0	0	0	1	1	1	1
NYCity	1,191	1,398	1,389	1,449	1,718	1,873	2,269	2,489	2,662	2,608
Long Island	583	642	711	733	955	1,010	1,347	1,495	1,623	1,496
Total	7,118	8,944	9,280	9,695	11,078	11,629	13,099	14,097	14,883	14,745

- ◆ Higher ISONE imports in 2013-2018 compared to 2009-2012
- ◆ Higher IESO imports in 2009
 - *Investigating both*

Projected Generator Payment Source: NYISO CARIS Base Cases (does not include Virtuals and Transmission outages)

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Zonal LBMPs Projected - Preliminary Results

Area	LBMP \$/MWh									
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
West	44.19	55.63	57.28	59.92	63.72	66.20	72.44	76.37	79.79	79.773
Genessee	44.89	55.46	57.16	59.61	63.23	65.66	72.59	76.43	79.44	78.716
Central	44.95	55.77	57.56	60.00	65.13	67.72	76.11	80.64	84.71	86.143
North	44.87	55.73	57.56	59.89	64.80	67.37	76.39	81.01	85.11	86.607
Mohawk Valley	45.04	55.90	57.78	60.13	65.28	67.87	76.62	81.24	85.34	86.787
Capital	45.01	56.56	58.48	60.82	69.66	72.35	79.01	83.71	87.77	90.803
Hudson Valley	47.18	58.33	60.92	63.12	69.53	72.45	79.95	84.72	89.03	90.735
Millwood	47.06	58.81	61.59	63.79	69.85	72.84	80.29	85.08	89.44	90.983
Dunwoodie	47.09	59.05	61.69	63.87	69.91	72.91	80.45	85.26	89.64	91.091
NYCity	50.26	64.31	65.42	68.04	73.69	78.23	85.34	90.54	95.40	96.394
Long Island	47.61	60.77	62.96	64.99	70.14	73.13	80.49	85.24	89.60	91.130
Average	46.19	57.85	59.85	62.20	67.72	70.61	78.15	82.75	86.84	88.11

Projected Generator Payment Source: NYISO CARIS Base Cases (does not include Virtuals and Transmission outages)

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Zonal Congestion in million \$ Historical

Area	Historical				
	2004	2005	2006	2007	2008
West	(1)	(5)	1	(14)	(25)
Genessee	1	(1)	2	(14)	(9)
Central	0	(1)	3	9	18
North	(0)	(1)	(0)	(0)	(2)
Mohawk Valley	0	(0)	2	5	10
Capital	7	19	27	74	143
Hudson Valley	5	20	54	87	175
Millwood	3	12	27	31	78
Dunwoodie	4	24	44	56	124
NYCity	582	809	673	700	1,403
Long Island	229	508	708	518	624
Total	831	1,382	1,541	1,451	2,540

Historical Congestion Source: PROBE DAM quarterly reports; DAM data include Virtual bidding & Transmission planned outages

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Zonal Congestion Projected - Preliminary Results

Congestion Demand Payment m\$										
Area	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
West	(12)	1	(2)	2	(18)	(22)	(73)	(87)	(100)	(128)
Genessee	(0)	(3)	(4)	(3)	(18)	(21)	(46)	(56)	(70)	(98)
Central	1	1	1	2	7	7	(6)	(7)	(8)	(6)
North	(0)	0	(0)	(0)	(0)	0	(0)	(0)	(0)	1
Mohawk Valley	2	2	2	2	5	5	2	2	2	3
Capital	2	11	12	12	68	69	35	37	36	60
Hudson Valley	30	35	47	44	64	68	45	49	52	55
Millwood	8	11	15	12	19	20	13	14	15	16
Dunwoodie	19	28	35	31	42	45	31	33	35	35
NYCity	392	625	581	606	683	822	669	722	778	754
Long Island	79	138	151	145	147	157	107	112	119	118
Total	520	851	838	854	998	1,150	778	819	859	809

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- ◆ Higher Ontario Hydro Imports in 2009 compared to 2010-2018
- ◆ Drop in NY City and LI in 2015

Projected Congestion Source: NYISO CARIS Base Cases (does not include Virtuals and Transmission outages)

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Historical Congestion (million \$)

Monitored Facility	Contingency	2004	2005	2006	2007	2008
CENTRAL EAST - VC	Base Case	52	102	187	571	1,199
PLSNTVLY 345 LEEDS 345 1	ATHENS__-PLSNTVLY_345_91	24	164	441	410	642
DUNWODIE 345 SHORE_RD 345 1	SPRNBK-EGRDNCTR-Y49	141	269	444	182	99
DUNWODIE 345 SHORE_RD 345 1	Base Case	11	56	37	77	80
RAINEY 138 VERNON 138 1	Base Case	5	84	21	19	81
MOTTHAVN 345 RAINEY 345 2	MOTTHAVN-RAINEY__345_Q11	-	-	-	33	137
RAINEY__345 DUNWODIE 345 1	W49TH_ST345_E13THSTA345AM5	165	-	-	1	-
RAINEY__138 VERNON__138 1	TWR: 22 21 A2253	145	-	-	-	-
MOTTHAVN 345 RAINEY 345 1	MOTTHAVN-RAINEY__345_Q12	-	-	-	10	120
GREENWD 138 VERNON 138 1	Base Case	-	-	-	49	62
GREENWD 138 KENTAVE 138 1	Base Case	-	-	31	19	27
UPNY CONED	Base Case	25	11	16	1	24
LEEDS 345 N.SCTLND 345 1	N.SCTLND-LEEDS__345_94-LN	-	-	4	7	48
LEEDS 345 N.SCTLND 345 1	TWR:UCC2-41 FCC-33	-	-	5	-	36
SPRNBK 345 EGRDNCTR 345 1	TWR:W73 W74 W89 W90 Y50 BK2	-	0	1	2	27
TOTAL EAST	Base Case	-	1	1	0	23
MOTTHAVN 345 DUNWODIE 345 2	DUNWODIE-MOTTHAVN_345_71	-	-	-	0	13

Historical Congestion Source: PROBE DAM quarterly reports; DAM data include Virtual bidding & Transmission planned outages

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Projected Congestion

Type	Long Name	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
Interface	CENTRAL EAST	0	50	47	51	461	461	235	241	228	398	2,172
Contingency	ATHENS_PLTVLLEY_345__PLTVLLEY_LEEDS 3_2	239	247	341	330	112	153	71	67	96	26	1,681
Contingency	NY MTHAVN-RAINY Q12__RAINEY_MOTT HAVEN_3		118	76	99	98	135	114	119	130	150	1,040
Interface	NYCLP Greenwood	70	44	42	26	32	37	24	37	40	5	356
Contingency	FRKILLS_WILOWBK1_138__FRESH KILLS_WILOWBK2_1		16	19	21	27	34	39	42	46	39	281
Contingency	GOTHLSN_GOWANUSN_345__GOTHLS S_GOWANUSS	3	8	11	14	19	24	25	27	29	36	196
Branch	E179 ST_15055 SR_1		1	17	17	15	21	20	20	22	17	150
Contingency	QUENBRG_VERNE_138_E179 ST_15055 SR_1		8	12	14	14	18	19	18	19	24	145
Interface	LI - ISONE	-	27	22	21	3	4	4	5	6	3	95
Contingency	GOTHLSS_GOWANUSS_345__GOTHLS S_GOWANUSS	(0)	9	6	6	7	10	9	10	11	17	86
Branch	SCOTT_19B3N PS_1	(0)	3	3	4	6	7	13	17	19	12	83
Interface	Dunwoodie (I) to Long Island (K)		32	20	18	4	4	1	1	1	1	82
Branch	E179 ST_S CREEK_2	(0)	(0)	6	8	8	12	10	11	13	14	82
Branch	PEACHBTM_PCHBTM_1	3	10	22	5	5	0	13	6	12	-	76
Contingency	PACK2_NIAG2W&2E_230__PACKARD2_NIAGAR2W_2	0	10	10	12	8	10	2	2	5	9	69
Contingency	NY MTHAVN-RAINY Q12__RAINEY_MOTT H_3	57										57
Contingency	SBK:NIAG2W_NIAGE__PACKARD2_PACK(N)E_1	-	1	2	3	6	5	3	5	12	16	53
Contingency	ERIE-E_S.RIPLY_230__HILSD230_E.TWANDA_1	0	12	13	12	4	4	1	1	1	3	51
Contingency	GOTHN_GOWANN_345__GOTHLS N_GOWANUSN_1	3	2	2	2	4	4	9	11	12	2	50
Contingency	LEEDS3_N.SCOT99_345__LEEDS 3_N.SCOT77_1	6	14	14	14	-	-	-	0	-	0	48
Interface	DYSINGER EAST-OP	-	(2)	(1)	(2)	(1)	(1)	(3)	(4)	(5)	(7)	(27)
Contingency	HUDAVEAST_JAMAICA_138__HUDAVE E_JAMAICA_1	(0)	(0)	(3)	(4)	(4)	(5)	(4)	(4)	(5)	(5)	(34)
Interface	WEST CENTRAL-OP	-	(0)	(0)	(0)	(42)	(48)	(82)	(96)	(130)	(238)	(637)

Congestion on PARs not included. See next slide.

Consistent themes from metrics in 2009, 2013 and 2015

Projected Congestion Source: NYISO CARIS Base Cases (does not include Virtuals and Transmission outages)

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Projected Congestion

Type	Long Name	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
Interface	PAR-BAL FARAGUT	35	70	67	82	101	132	134	143	159	173	1,096
Interface	IMO-MISO	(13)	43	46	59	80	93	150	188	221	155	1,024
Interface	ABCJK PAR IMBALANCE	46	27	22	23	43	46	43	45	42	80	416
Branch	L SUCS_L SUCSPH_1	5	11	1	2	4	6	6	7	7	9	59
Interface	PAR JK 1000MW Wheel	(0)	(0)	(1)	(1)	(2)	(3)	(5)	(6)	(6)	(15)	(40)
Interface	FARRAGUT 1000MW WHEEL	4	7	(3)	(3)	(16)	(17)	(27)	(25)	(39)	(15)	(132)
Branch	STLAWR33_STLAWL33_33	2	(6)	(7)	(8)	(17)	(20)	(39)	(49)	(58)	(58)	(260)
Branch	STLAWR34_STLAWL34_34	3	(9)	(11)	(11)	(26)	(29)	(57)	(71)	(85)	(86)	(383)

Congestion shown on PARs only

- ◆ Higher Congestion in the later years

Projected Congestion Source: NYISO CARIS Base Cases (does not include Virtuals and Transmission outages)

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Next Steps

- ◆ Tune Cases - Finalize Congestion forecast
- ◆ Determine three studies
- ◆ Cost/Benefit analysis on generic solutions
- ◆ Scenarios on three studies
- ◆ CARIS report

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The New York Independent System Operator (NYISO) is a not-for-profit corporation that began operations in 1999. The NYISO operates New York's bulk electricity grid, administers the state's wholesale electricity markets, and provides comprehensive reliability planning for state's bulk electricity system.

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