

CONGESTION ISSUES

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PJM – Example of congestion impact on project economics



- Significant congestion costs experienced by project in a few days due to local planned and unplanned transmission outages (see next slide)

March Transmission Outages at Kankakee, Bradley and Davis Creek

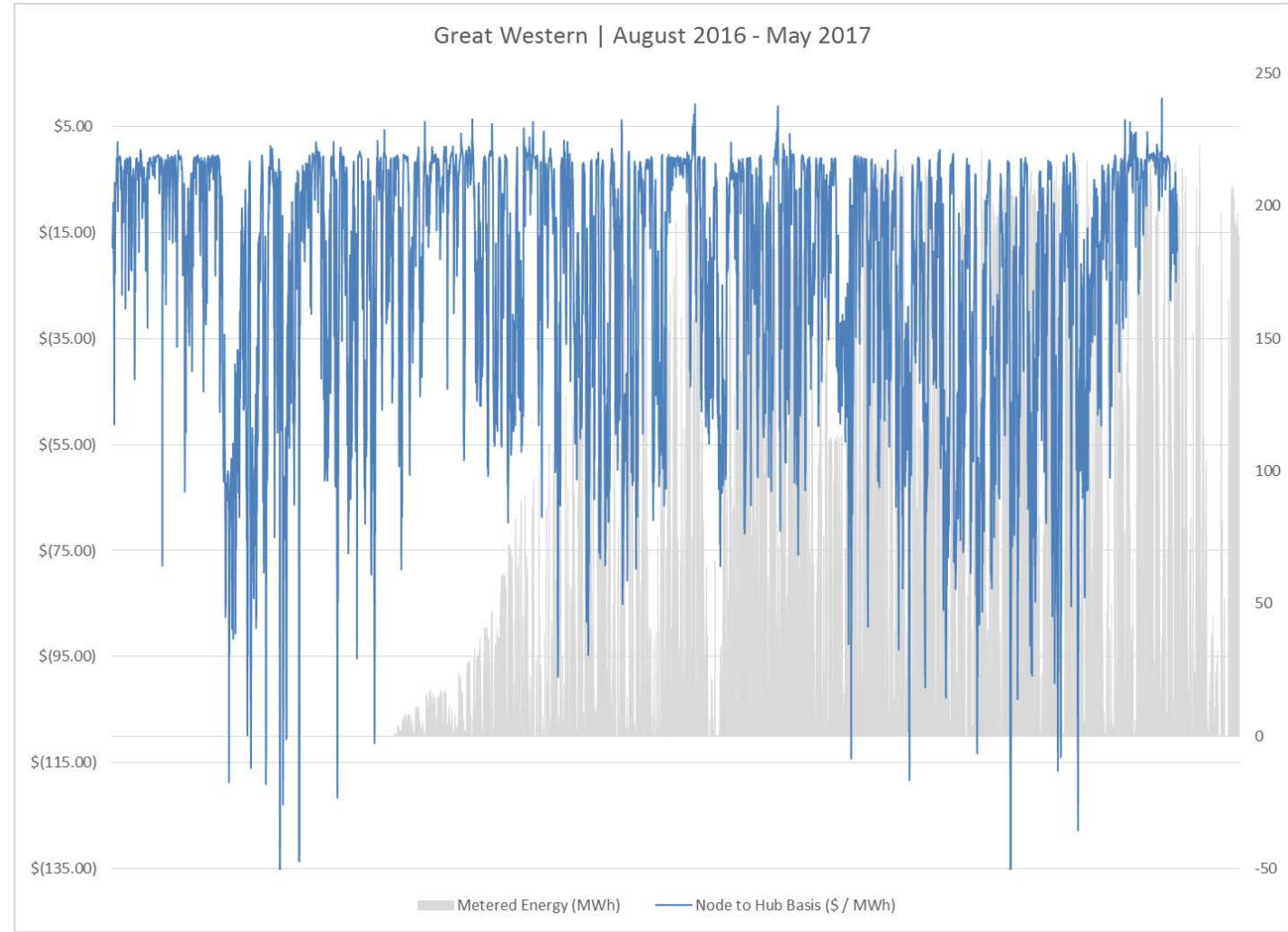
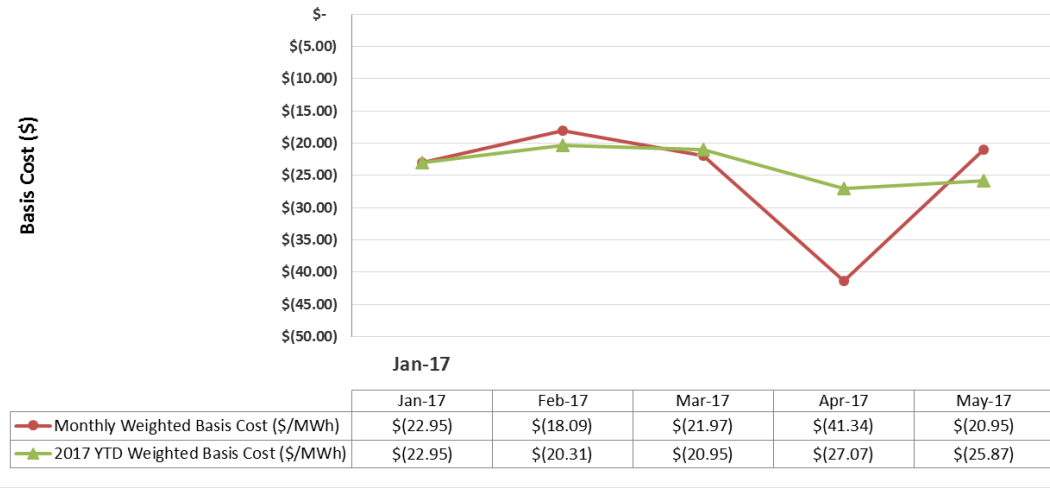
Transmission Facility Name	Equipment Type	Voltage	Start Datetime - Actual	End Datetime - Actual	Ticket Number	Outage Status	Request Type
199 KENS-8603 8603 Z1	Transmission Line	138	3/21/2017 20:00	3/25/2017 13:00	675135	Complete	Scheduled
199 KENS-8605 8605 Z1	Transmission Line	138	3/2/2017 11:00	3/3/2017 16:00	0	Complete	Unscheduled
199 KENS-8605 8605 Z1	Transmission Line	138	3/19/2017 13:00	3/20/2017 1:00	0	Complete	Unscheduled
199 KENS-8605 8605 Z1	Transmission Line	138	3/28/2017 16:00	3/30/2017 1:00	0	Complete	Unscheduled
199 KENS-8605 8605 Z1	Transmission Line	138	3/30/2017 13:00	3/31/2017 23:00	0	Complete	Unscheduled
86 Davis Creek - 8603 8603 1	Transmission Line	138	3/21/2017 20:00	3/25/2017 11:00	675135	Complete	Scheduled
86 Davis Creek - 8605 8605 1	Transmission Line	138	3/28/2017 19:00	3/30/2017 1:00	0	Complete	Unscheduled
86 Davis Creek - 8605 8605 1	Transmission Line	138	3/30/2017 13:00	3/31/2017 23:00	0	Complete	Unscheduled
8603 8603_4SD SER DEV	Series Reactor	138	3/21/2017 21:00	3/25/2017 11:00	675135	Complete	Scheduled
8605 8605_6SD SER DEV	Series Reactor	138	3/28/2017 19:00	3/30/2017 1:00	0	Complete	Unscheduled
Rad DAVIS CREEK - BRADLEY 8605 2	Transmission Line	138	3/28/2017 19:00	3/30/2017 1:00	0	Complete	Unscheduled
Rad DAVIS CREEK-BRADLEY 8603	Transmission Line	138	3/19/2017 11:00	3/19/2017 19:00	0	Complete	Unscheduled
Rad DAVIS CREEK-BRADLEY 8603	Transmission Line	138	3/21/2017 19:00	3/25/2017 14:00	675135	Complete	Scheduled
Rad DAVIS CREEK-BRADLEY 8603	Transmission Line	138	3/21/2017 21:00	3/25/2017 13:00	675135	Complete	Scheduled
Rad DAVIS CREEK-BRADLEY 8605	Transmission Line	138	3/2/2017 11:00	3/3/2017 16:00	674292	Complete	Scheduled
Rad DAVIS CREEK-BRADLEY 8605	Transmission Line	138	3/28/2017 17:00	3/30/2017 1:00	0	Complete	Unscheduled
Rad DAVIS CREEK-BRADLEY 8605	Transmission Line	138	3/28/2017 19:00	3/30/2017 1:00	0	Complete	Unscheduled
Rad DAVIS CREEK-BRADLEY 8605	Transmission Line	138	3/28/2017 19:00	3/30/2017 1:00	0	Complete	Unscheduled
Rad DAVIS CREEK-BRADLEY 8605	Transmission Line	138	3/30/2017 13:00	3/31/2017 23:00	0	Complete	Unscheduled
Rad DAVIS CREEK-BRADLEY 8605	Transmission Line	138	3/30/2017 13:00	3/31/2017 23:00	0	Complete	Unscheduled
Rad DAVIS CREEK-BRADLEY 8605	Transmission Line	138	3/30/2017 13:00	3/31/2017 23:00	0	Complete	Unscheduled

Source: ABB Ventyx

Another Example: Node to Hub Basis

- 225 MW Wind Project
- Settled at Hub

Great Western Basis Summary



Project Curtailment

2017 has seen increased curtailment through the first 4 months. Value of lost production is over \$2MM YTD.

Month	Jan	Feb	Mar	Apr	May
Actual Production	25,644	27,701	27,601	23,112	19,517
Lost production	3,082	4,337	4,799	10,910	10,760
Total Potential	28,726	32,038	32,400	34,022	30,277
% lost production	10.73%	13.54%	14.81%	32.07%	35.54%

Primarily constraint is the **Goodland to Reynolds** line. Affected by many factors/outages: Examples below:

Jan 9-12

Breakers at Schahfer
138_Xfer2_Mo@Hartsdal
No_2_Xfer@Hartsdal

Jan 16-17

138_Xfer_Breaker@Schahfer
Schahfer in NIPS

Feb 10-12

No_1_XFMR @Magnetron

April 4-11

08LAF08SPN13_1: 08Lafyte to 08SPNGBR

April 25-27

Shadelnd Shad3lnd Shadelafay13_1_1

May 1-2

Several outages in the area.

May 17-19 Several strong correlations causing the constraint.

Name	KV	Miles	Active Hours	Overlap Hours	Outage Unique Hours	Constraint Unique Hours	Overlap %	Overlap-Constraint %	Dependence Factor ▼
Total activity for selected constraint(s)			49						
GREENKOKOM23_1 1 1: GREENTOW TO KOKOMO_E	230	45.6	63	49	14	0	78%	100%	71%
KOKOMWEBST23_1 1 1: KOKOMO_E TO WEBSTER	230	42.2	63	49	14	0	78%	100%	71%
23022-20 @ WEBSTER IN CIN	230	42.2	63	49	14	0	78%	100%	71%
230B2-22 @ WEBSTER IN CIN	230	42.2	63	49	14	0	78%	100%	71%
U16B-XFR6_BKR @ SCHAHFER IN NIPS	138	32.0	72	49	23	0	68%	100%	53%
34509 A 1: BURR_OAK TO LEESBURG	345	41.0	72	49	23	0	68%	100%	53%
138_XFR1_BKR @ REYNOLD4 IN NIPS	138	0.0	72	49	23	0	68%	100%	53%
345_XFR1_MO @ REYNOLD4 IN NIPS	345	0.0	72	49	23	0	68%	100%	53%
REYNOLD4 NO_1_XFMR 1	345	0.0	72	49	23	0	68%	100%	53%
34513 A 1: BURR_OAK TO SCHAHFER	345	32.0	72	49	23	0	68%	100%	53%
34513: BURR_OAK TO SCHAHFER	345	32.0	72	49	23	0	68%	100%	53%
U16A-U16B_BKR @ SCHAHFER IN NIPS	138	32.0	72	49	23	0	68%	100%	53%
34513_BKR @ BURR_OAK IN NIPS	345	41.0	72	49	23	0	68%	100%	53%
13819-XFR2_BKR @ BURR_OAK IN NIPS	138	41.0	72	49	23	0	68%	100%	53%
13882-XFR2_BKR @ BURR_OAK IN NIPS	138	41.0	72	49	23	0	68%	100%	53%
345_MO_G @ BURR_OAK IN NIPS	345	41.0	72	49	23	0	68%	100%	53%
34509-13_BKR @ BURR_OAK IN NIPS	345	41.0	72	49	23	0	68%	100%	53%
34509: BURR_OAK TO LEESBURG	345	41.0	72	49	23	0	68%	100%	53%
34509_BKR @ BURR_OAK IN NIPS	345	41.0	72	49	23	0	68%	100%	53%
KOKOMO_E BK1_230 1	230	45.6	72	49	23	0	68%	100%	53%
GBCS-PAXE-1 B 1: GBCS TO PAXT	138	47.3	72	49	23	0	68%	100%	53%
NO_2_XFMR @ BURR_OAK IN NIPS	345	41.0	72	49	23	0	68%	100%	53%
GBCS-PAXE-1: GBCS TO PAXT	138	47.3	72	49	23	0	68%	100%	53%
TR_1_138_69KV @ PAXT IN AMRN	138	47.3	72	49	23	0	68%	100%	53%
BK1 @ THORNTWN IN CIN	230	43.6	13	12	1	37	92%	24%	22%
U15_BKR @ SCHAHFER IN NIPS	345	32.0	2	2	0	47	100%	4%	4%