Biennial Transmission Project Report – Congestion Study

Executive Summary

In compliance with the Minnesota Public Utilities Commission's (Commission) June 29, 2022 Order, the Minnesota Transmission Owners (MTO) conducted this Congestion Study which includes information on: 1) expected sustained HVTL or generation planned outages; 2) whether those outages are anticipated to have new or incremental congestion; and 3) whether those outages are anticipated to contribute to sustained incremental congestion. The goal was to understand the dynamic nature that outages (both planned and forced) have on congestion.

Planned outages were taken from the Control Room Operating Window (CROW) system as of September 15, 2022. This is a continually updated system for known, planned outages in MISO, including all transmission voltage level facilities. Planned outages in CROW are subject to change. Forced outages are by nature unknown and can happen in any combination. Engineering judgement was used to select a set of high impact yet plausible forced outages in addition to planned outages. See the Model section for outages studied.

The analysis found that congestion increased with outages, as shown in the table below. This table shows the percent of time with any congestion present in LRZ1 footprint.

System Intact	CROW	CROW+Forced
91%	93%	97%

Average locational marginal pricing (LMP) for LRZ1 areas during the 90 day-period period were estimated at:

Area	Avg LMP System Intact	Avg LMP CROW	Avg LMP CROW+Forced
DPC	$31.35	$32.13	$35.15
GRE	$26.55	$27.79	$27.30
MDU	$24.15	$35.04	$33.82
MP	$30.43	$27.28	$27.58
NSP	$27.63	$29.75	$30.52
OTP	$26.29	$25.72	$23.00
SMP	$26.48	$27.94	$29.17

Observations

- Congestion is typically highest in times with high wind around the morning or evening peak load.
- The system intact operating state has baseline congestion.
- The operating state with CROW outages increases congestion moderately (see page 60 for details).
- The operating state with CROW and a selected set of forced outages also increases congestion moderately (see page 60 for details).

- Patterns in all of the operating states show congestion between:
    - Wind generation areas in southwest Minnesota and the Twin Cities metro
    - Minnesota and Wisconsin
    - Twin Cities and northern Minnesota
    - Dakotas/far western Minnesota and the rest of Minnesota

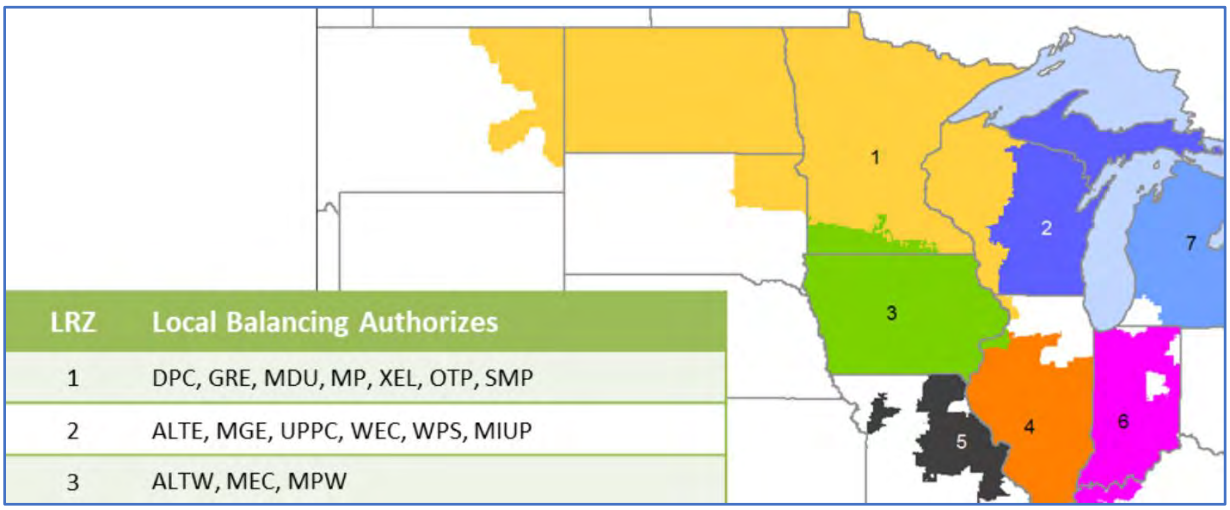
Model

Future congestion was simulated using the MISO MTEP21 Future 1 2025 as the source model and then adjusted to represent the system conditions for the 90-day period between September through December 2022. The source model uses 2018 weather data for wind and solar output profiles, representing a typical year, and does not forecast 2022 weather, so a direct hour by hour comparison of results to actual congestion will be different due to weather patterns.

Three operating states of the electric grid were simulated:

- System Intact – Baseline with all transmission available
- Control Room Operating Window (CROW) – Planned outages added (see Addendum 1 for list of modeled outages)
- Forced Outages – Select possible forced outages in addition to planned outages
    - King to Eau Claire 345 kV
    - Hankinson to Wahpeton 230 kV
    - Crandal to Wilmarth 345 kV

Shadow price sums reported are a measure of the relative impact of constraints and do not represent to cost savings of fixing the constraint. Fuel mix and load is reported for MISO North in MWh. Constraints are reported for the LRZ1 (footprint as shown below).



LRZ	Local Balancing Authorizes
1	DPC, GRE, MDU, MP, XEL, OTP, SMP
2	ALTE, MGE, UPPC, WEC, WPS, MIUP
3	ALTW, MEC, MPW

System Intact Operating State

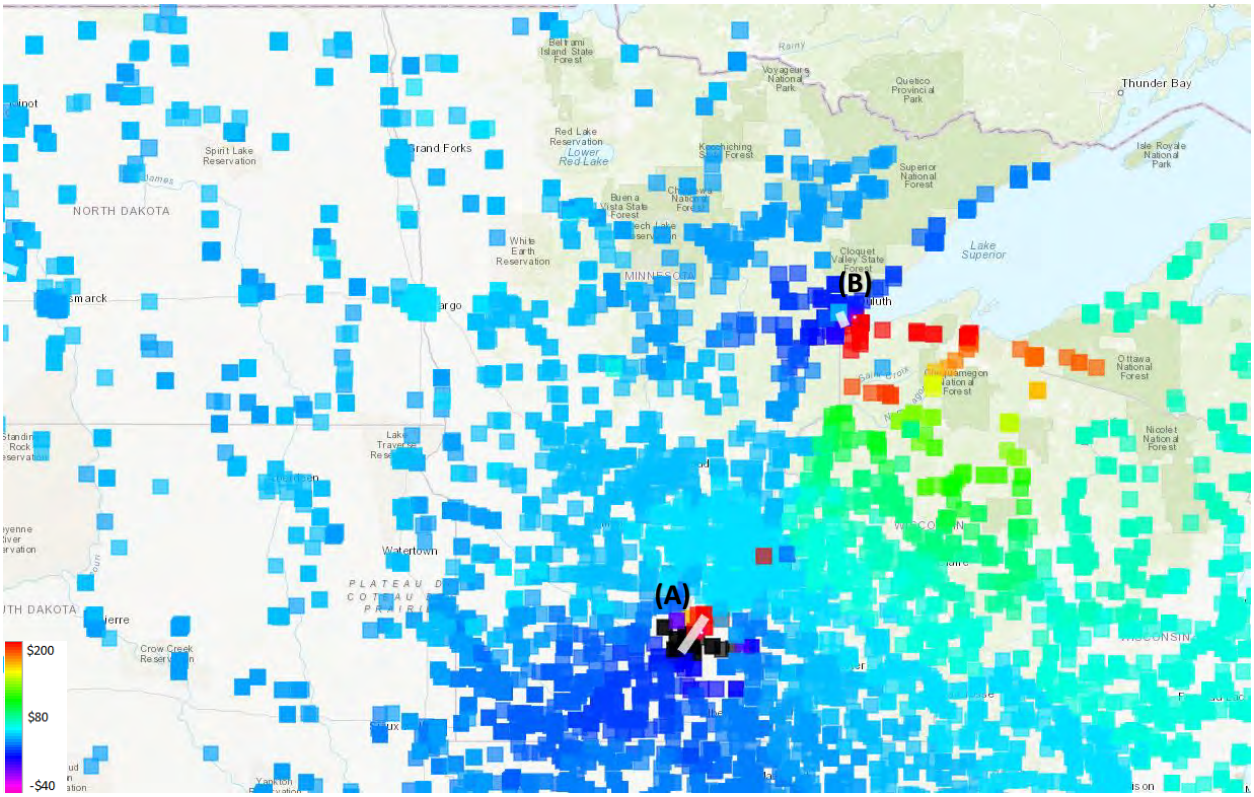
The table below provides a weekly summary table of congestion and generation fuel mix (MWh) in the study footprint for baseline congestion. Shadow Sum is the sum of Shadow prices for all constraints over

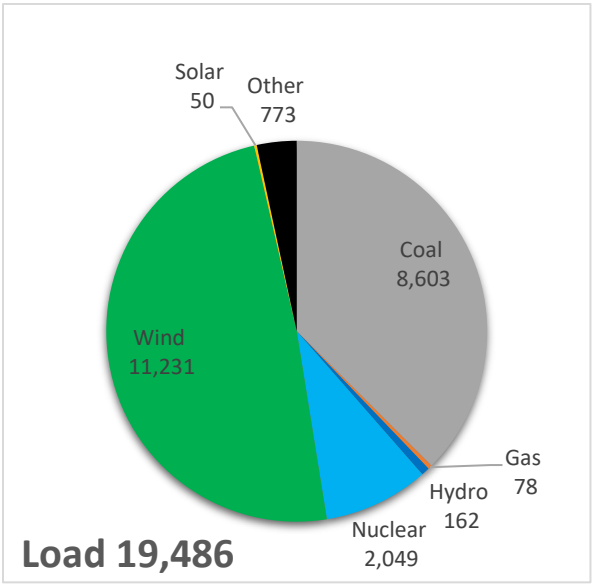
the 168 hours in the week in $/MWh. The shadow price contribution of top three constraints for the week are reported in the next column.

Week Of	Hours Congested	Shadow Sum	Top 3 constraints for the week	Coal	Gas	Hydro	Nuclear	Wind	Solar	Other	Load	Worst Hour
8/29/2022	151	$45,275	[$34,028] HIBBARD7 to WNTR ST7 #1 [$5,902] GRE-CLVLAND8 to LECENTR8 #1 [$2,166] BIGSTON4 to BROWNSV4 #1	1,349,734	82,731	31,550	344,180	1,248,348	17,553	126,987	2,825,102	8/30/2022 7:00
9/5/2022	162	$27,149	[$18,377] HIBBARD7 to WNTR ST7 #1 [$3,025] BEULAH 7 to COYOTE 7 #1 [$1,375] SOURIS 7 to MAGIC CITY 7 #1	1,534,080	234,886	30,725	344,180	999,043	16,191	103,660	3,117,422	9/5/2022 7:00
9/12/2022	145	$49,369	[$37,349] HIBBARD7 to WNTR ST7 #1 [$3,602] HOOT LK7 to FERGSFL7 #1 [$3,439] SPLT RK3 to WHITE 3 #1	1,250,232	94,661	30,746	344,180	1,326,042	23,411	149,990	2,788,925	9/15/2022 21:00
9/19/2022	156	$34,011	[$23,163] HIBBARD7 to WNTR ST7 #1 [$4,510] GRE-CLVLAND8 to LECENTR8 #1 [$2,711] SPLT RK3 to WHITE 3 #1	1,292,312	59,615	29,932	344,180	1,220,732	18,767	131,583	2,660,315	9/19/2022 21:00
9/26/2022	153	$42,699	[$34,607] HIBBARD7 to WNTR ST7 #1 [$1,646] HOOT LK7 to FERGSFL7 #1 [$1,561] FORMN 7 to FORMAN 7 #1	1,433,699	25,507	31,617	357,462	1,190,788	16,186	129,196	2,706,386	9/29/2022 7:00
10/3/2022	149	$10,883	[$5,203] GRE-CLVLAND8 to LECENTR8 #1 [$2,935] BEULAH 7 to COYOTE 7 #1 [$1,442] HIBBARD7 to WNTR ST7 #1	1,518,947	61,074	34,496	357,462	948,807	11,825	109,287	2,730,248	10/6/2022 7:00
10/10/2022	163	$14,283	[$5,998] HIBBARD7 to WNTR ST7 #1 [$2,568] ABDNJCT7 to ELLENDL7 #1 [$2,183] BEULAH 7 to COYOTE 7 #1	1,434,861	30,046	34,057	357,462	1,175,109	11,603	122,009	2,732,530	10/13/2022 11:00
10/17/2022	136	$16,132	[$9,308] HIBBARD7 to WNTR ST7 #1 [$1,400] BROWNSV4 to NEW EFFNGTN4 #1 [$1,298] WABACO 5 to ALMA 5 #1	1,126,084	17,862	33,975	357,462	1,685,845	22,418	153,180	2,732,497	10/23/2022 14:00
10/24/2022	149	$17,543	[$8,227] HIBBARD7 to WNTR ST7 #1 [$4,767] SPLT RK3 to WHITE 3 #1 [$1,645] ABDNJCT7 to ELLENDL7 #1	1,575,504	35,337	33,958	357,462	957,309	15,199	115,432	2,754,787	10/30/2022 19:00
10/31/2022	152	$12,994	[$4,086] BROWNSV4 to NEW EFFNGTN4 #1 [$3,015] BEULAH 7 to COYOTE 7 #1 [$2,258] HIBBARD7 to WNTR ST7 #1	1,552,588	125,230	35,742	357,462	1,035,157	12,668	118,151	2,854,835	11/1/2022 15:00
11/7/2022	160	$15,536	[$4,365] BROWNSV4 to NEW EFFNGTN4 #1 [$4,348] HIBBARD7 to WNTR ST7 #1 [$2,090] GRE-CHUBLAK7 to YBUS(GRE-CHUBLAK3,GRE-CHUBLAKT) #1	1,474,136	82,823	36,982	357,462	1,321,430	12,316	128,056	2,904,752	11/9/2022 8:00
11/14/2022	142	$16,027	[$5,442] HIBBARD7 to WNTR ST7 #1 [$4,483] BROWNSV4 to NEW EFFNGTN4 #1 [$2,187] ABDNJCT7 to ELLENDL7 #1	1,366,327	40,290	36,163	357,462	1,422,910	17,868	139,715	2,751,243	11/18/2022 11:00
11/21/2022	142	$18,008	[$4,817] BROWNSV4 to NEW EFFNGTN4 #1 [$3,233] HIBBARD7 to WNTR ST7 #1 [$3,108] GRE-CLVLAND8 to LECENTR8 #1	1,487,493	23,123	36,885	357,462	1,495,216	14,904	141,479	2,912,069	11/26/2022 9:00
11/28/2022	163	$40,118	[$15,528] GRE-CLVLAND8 to LECENTR8 #1 [$15,017] BROWNSV4 to NEW EFFNGTN4 #1 [$4,133] FORMN 7 to FORMAN 7 #1	1,525,034	155,708	34,705	357,462	1,363,607	12,915	138,488	3,070,232	11/28/2022 19:00
12/5/2022	167	$33,494	[$11,803] GRE-SPRGCK15 to YBUS(GRE-SPRNGCK8,GRE-SPRNGC1T) #1 [$9,880] BROWNSV4 to NEW EFFNGTN4 #1 [$4,582] BEULAH 7 to COYOTE 7 #1	1,670,772	155,758	32,361	357,462	1,067,642	13,173	116,692	3,029,060	12/5/2022 9:00
12/12/2022	156	$17,520	[$3,263] SPLT RK3 to WHITE 3 #1 [$3,257] HIBBARD7 to WNTR ST7 #1 [$2,908] BEULAH 7 to COYOTE 7 #1	1,634,325	98,820	32,101	357,462	1,092,589	11,368	110,638	2,988,923	12/13/2022 23:00
12/19/2022	152	$40,126	[$13,795] GRE-CLVLAND8 to LECENTR8 #1 [$8,354] BROWNSV4 to NEW EFFNGTN4 #1 [$8,174] FORMN 7 to FORMAN 7 #1	1,479,119	45,147	31,597	357,462	1,542,914	14,538	138,396	2,943,363	12/23/2022 18:00
12/26/2022	162	$47,581	[$19,587] BROWNSV4 to NEW EFFNGTN4 #1 [$8,215] GRE-SPRGCK15 to YBUS(GRE-SPRNGCK8,GRE-SPRNGC1T) #1 [$7,538] GRE-CLVLAND8 to LECENTR8 #1	1,521,836	214,003	32,777	357,462	1,385,802	12,117	134,599	3,204,048	12/30/2022 19:00

Most congested hour maps

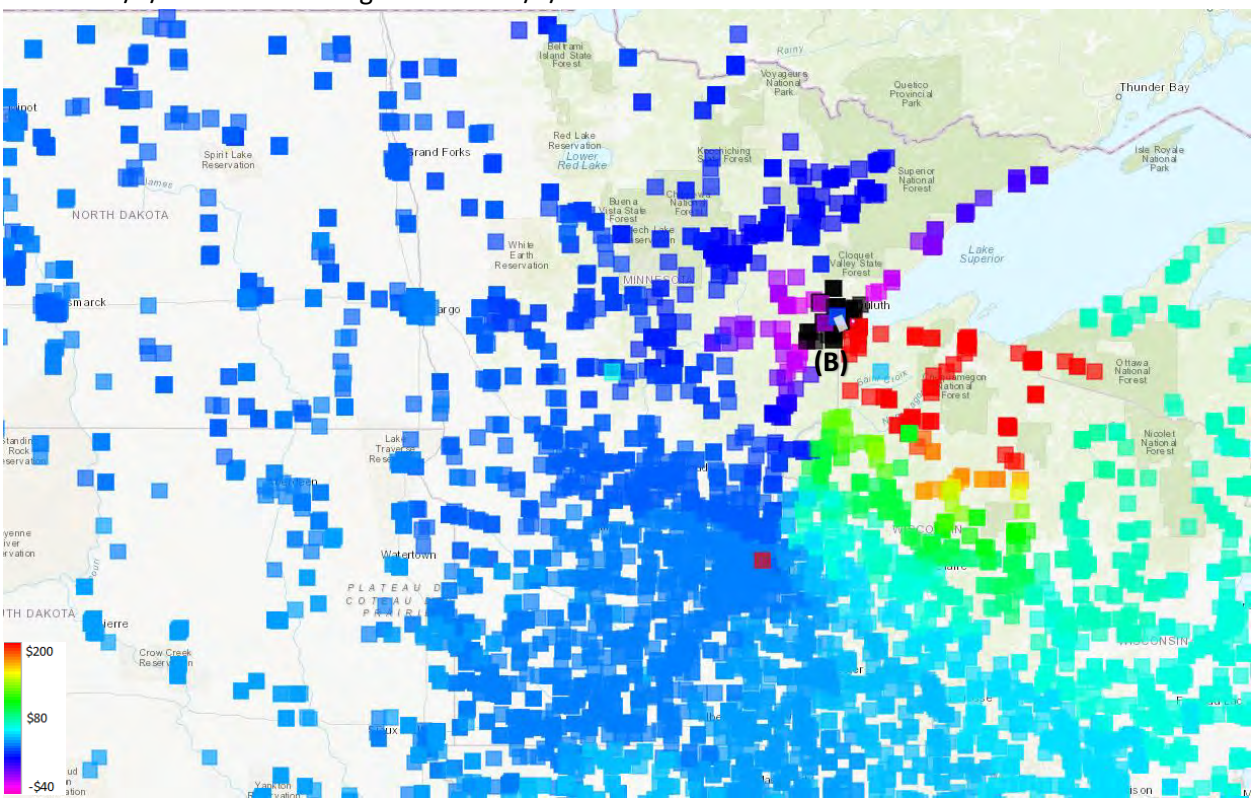
Week of 8/29/2022 Most congested hour 8/30/2022 7:00

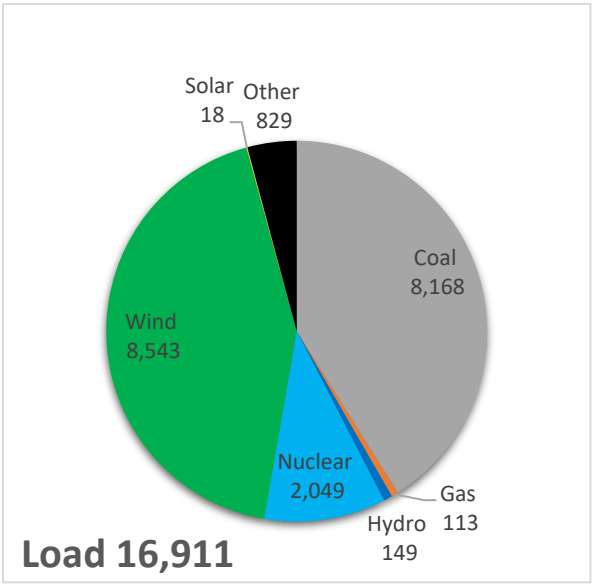




Wind generation is high and load is a moderate morning peak. The biggest constraints are:
(A) Cleveland to Le Center 69 kV in the event of an outage of Wilmarth to Sheas Lake 345 kV
(B) Hibbard to Winter Street 115 kV in the event of an outage of Arrowhead to Gary 115 kV (managed by the Stinson phase shifting transformer, which the analytical tool is unable to model)

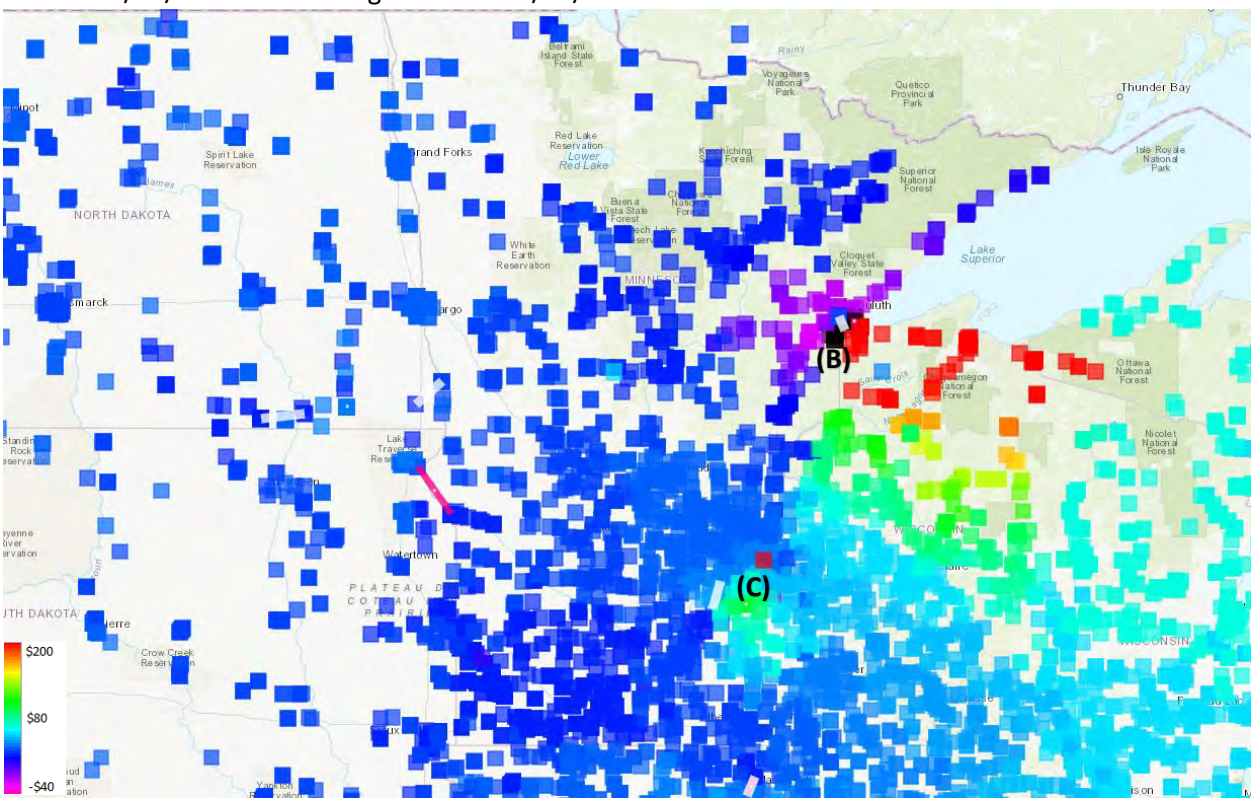
Week of 9/5/2022 Most congested hour 9/5/2022 7:00

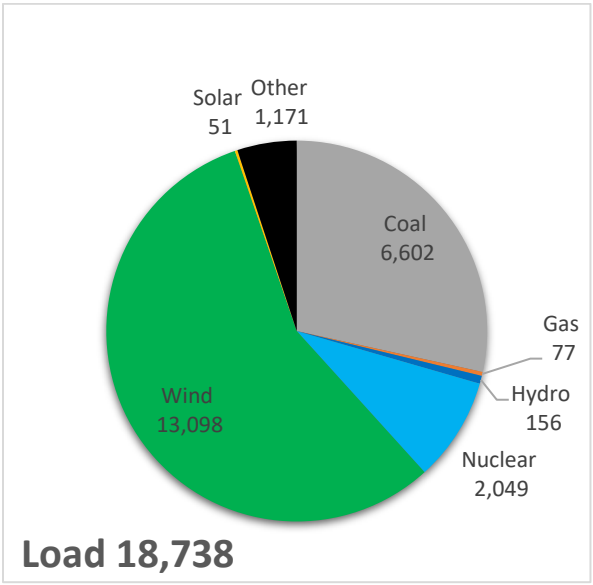




Wind generation is moderate and load is a low morning peak. The biggest constraint is:
(B) Hibbard to Winter Street 115 kV in the event of an outage of Arrowhead to Gary 115 kV (managed by the Stinson phase shifting transformer, which the analytical tool is unable to model)

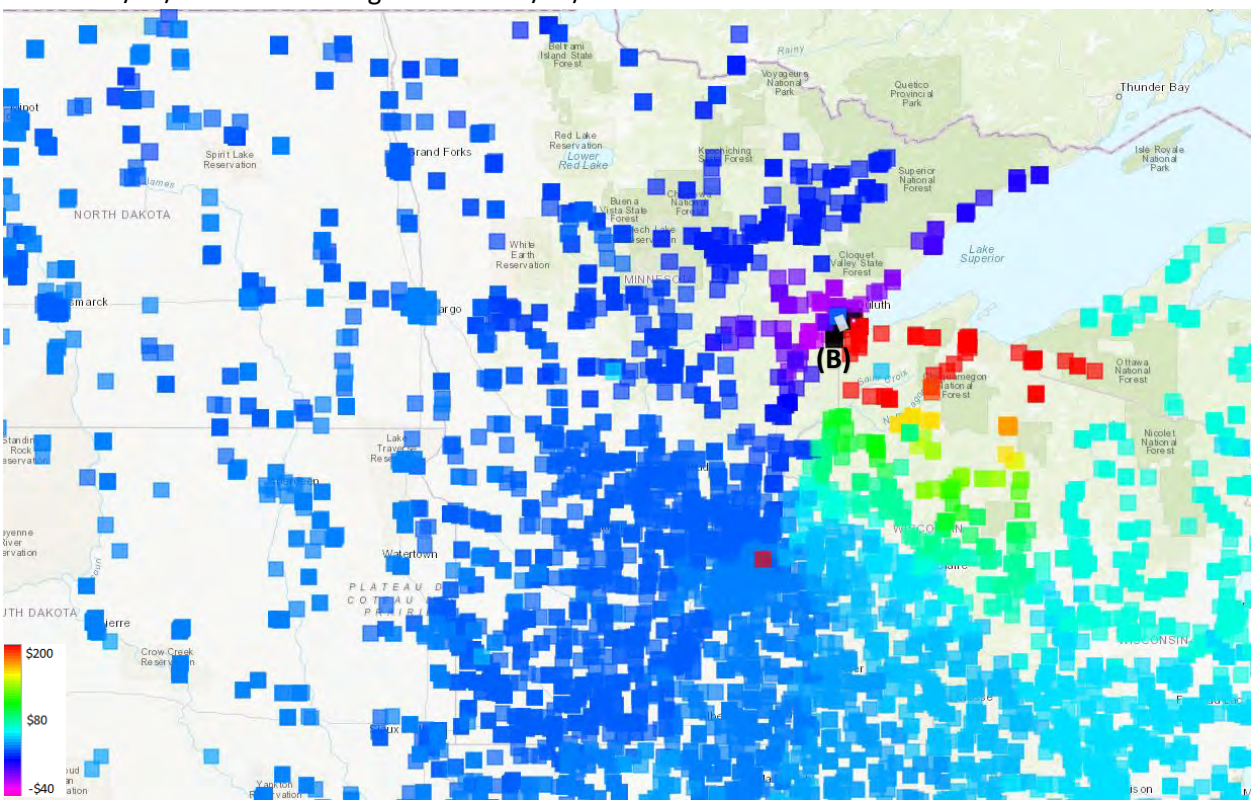
Week of 9/12/2022 Most congested hour 9/15/2022 21:00

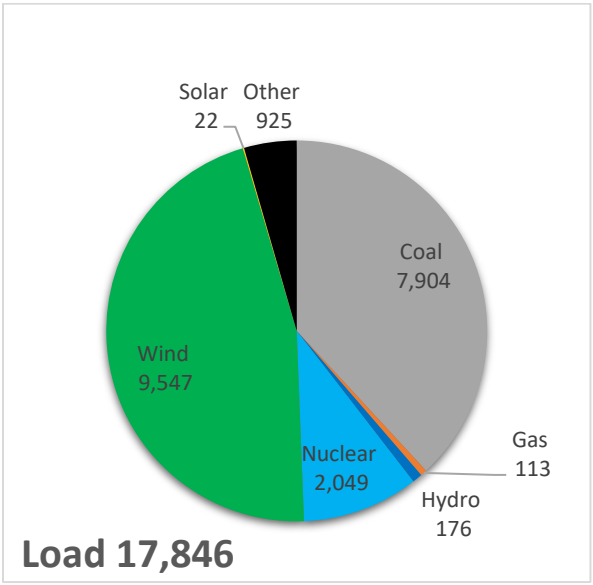




Wind generation is high and load is a moderate evening peak. The biggest constraints are:
(B) Hibbard to Winter Street 115 kV in the event of an outage of Arrowhead to Gary 115 kV (managed by the Stinson phase shifting transformer, which the analytical tool is unable to model)
(C) Chub Lake 345/115 kV transformer in the event of an outage of Helena to Scott County 345 kV (being addressed in MTEP process).

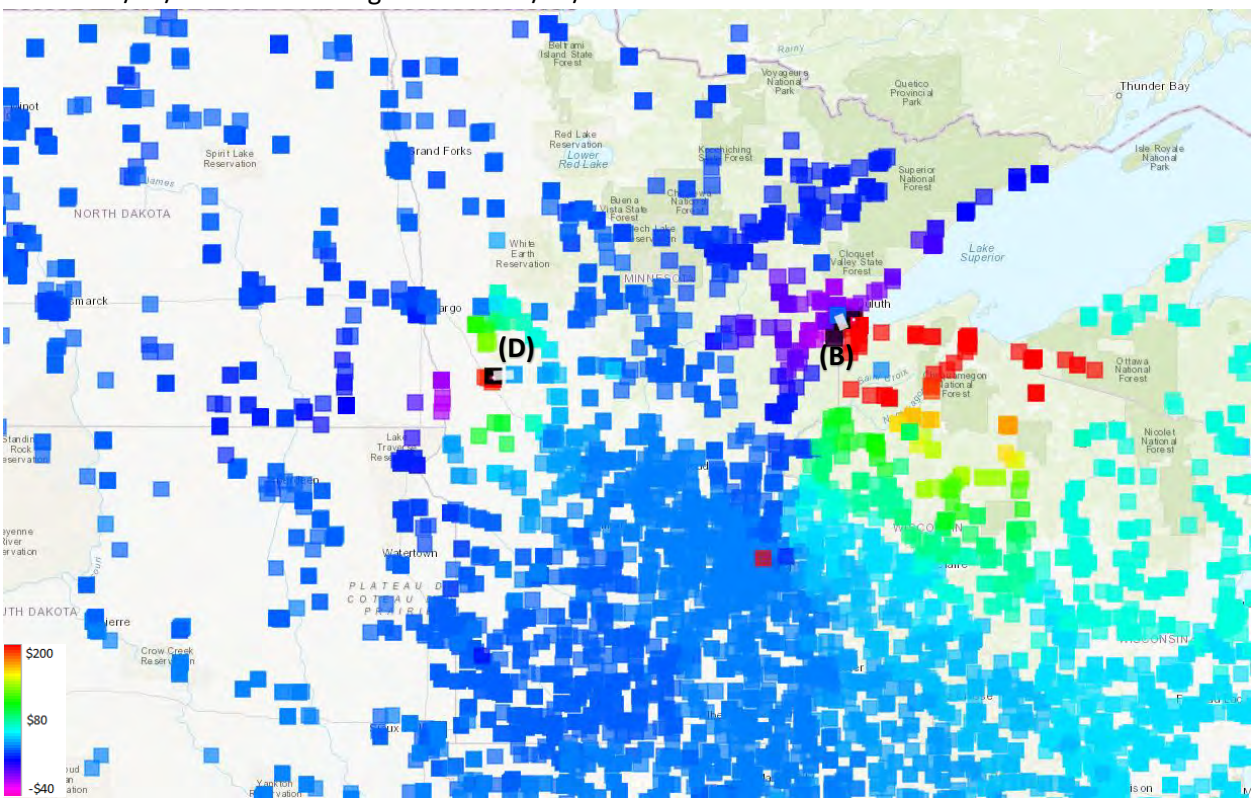
Week of 9/19/2022 Most congested hour 9/19/2022 21:00

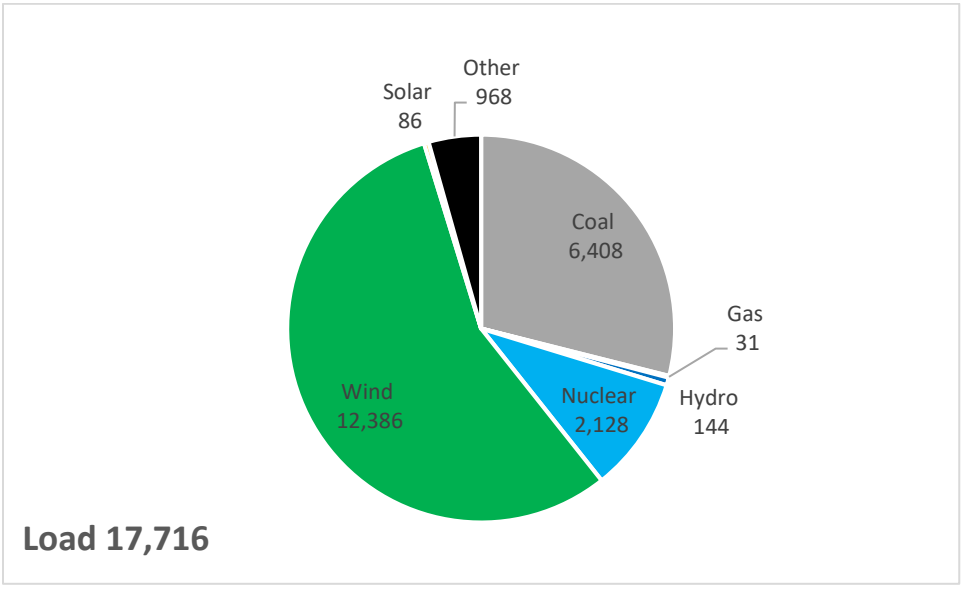




Wind generation is moderate and load is a moderate evening peak. The biggest constraint is:
(B) Hibbard to Winter Street 115 kV in the event of an outage of Arrowhead to Gary 115 kV (managed by the Stinson phase shifting transformer, which the analytical tool is unable to model)

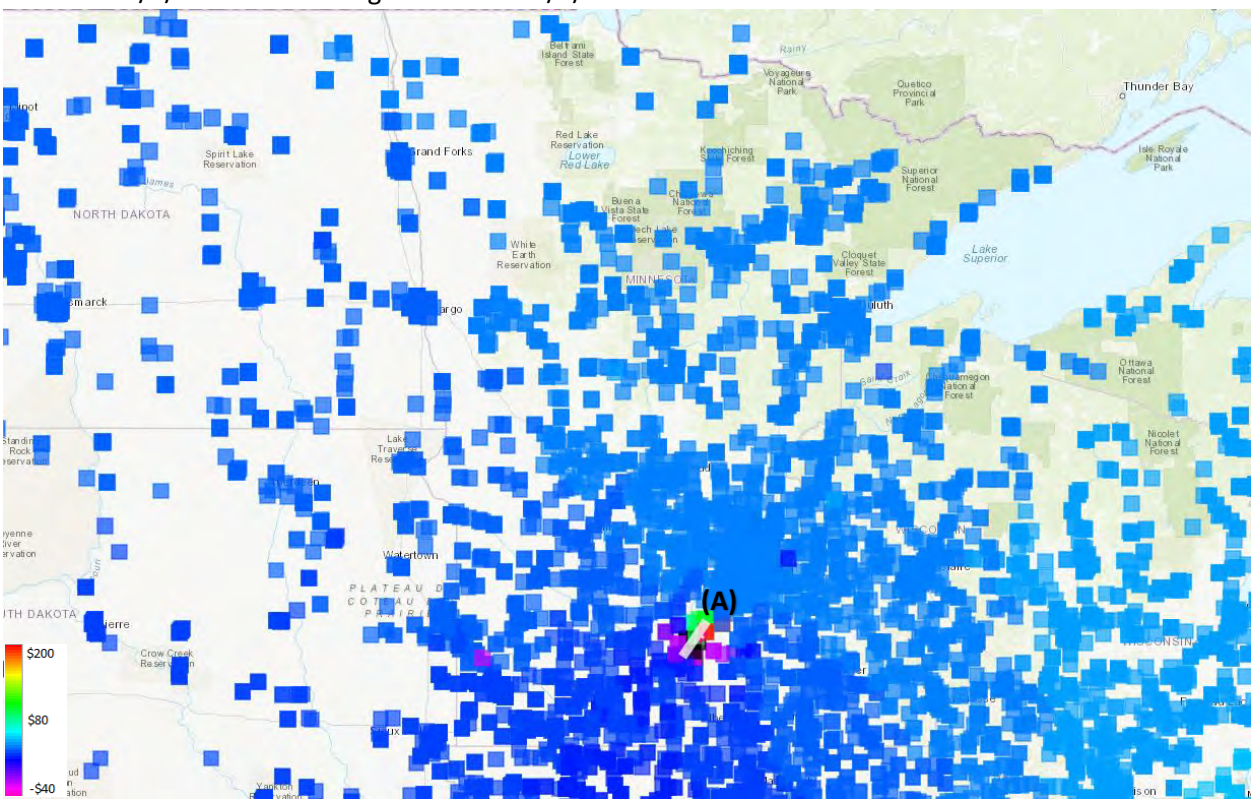
Week of 9/26/2022 Most congested hour 9/29/2022 7:00

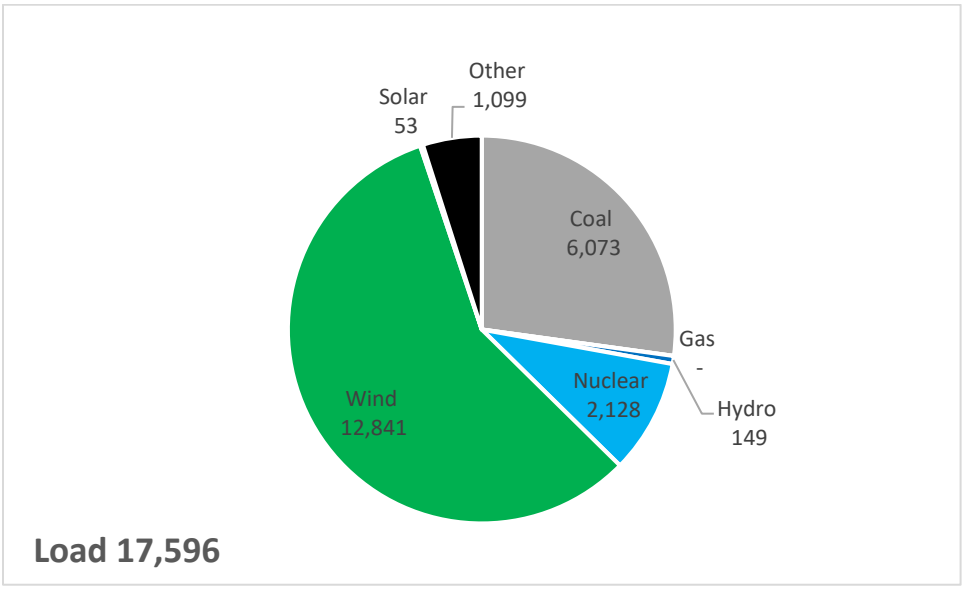




Wind generation is high and load is a moderate morning peak. The biggest constraints are:
(B) Hibbard to Winter Street 115 kV in the event of an outage of Arrowhead to Gary 115 kV (managed by the Stinson phase shifting transformer, which the analytical tool is unable to model)
(D) Hoot Lake to Fergus Falls 115 kV in the event of an outage of Fergus Falls to Silver Lake 230 kV.

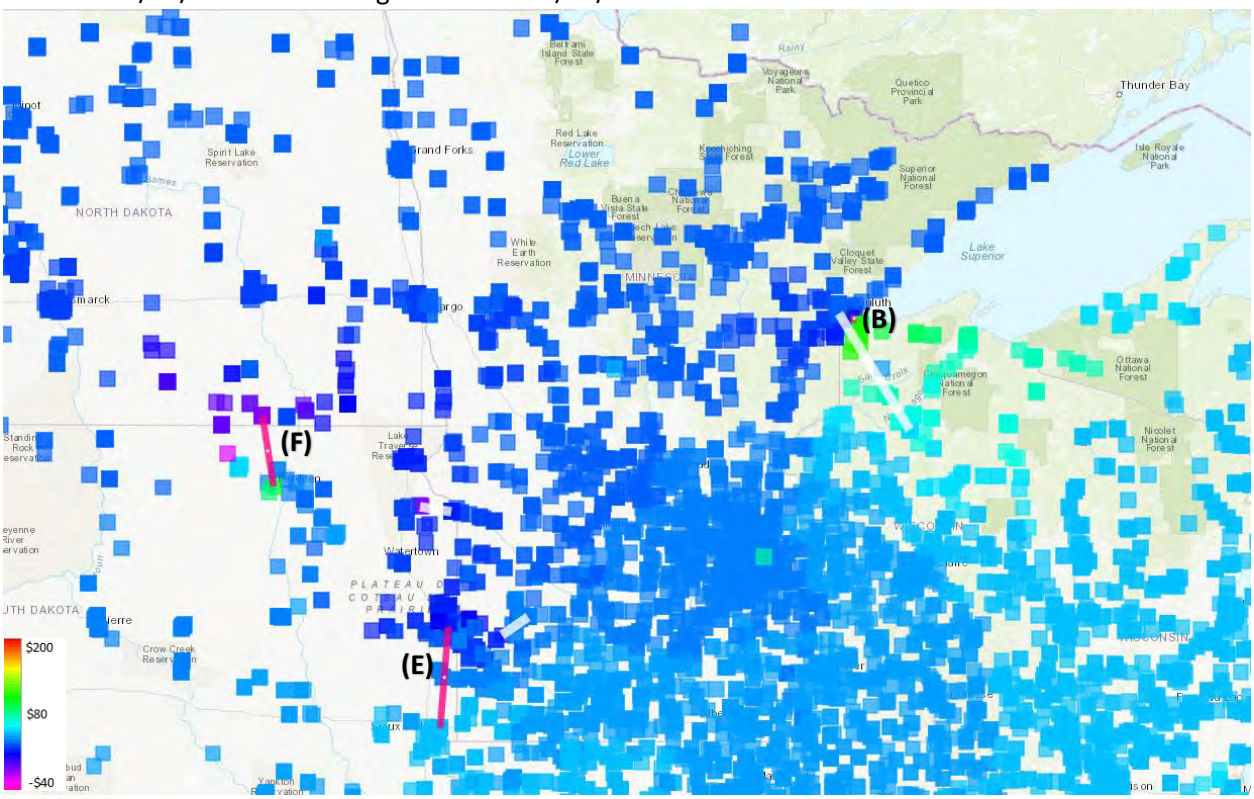
Week of 10/3/2022 Most congested hour 10/6/2022 7:00

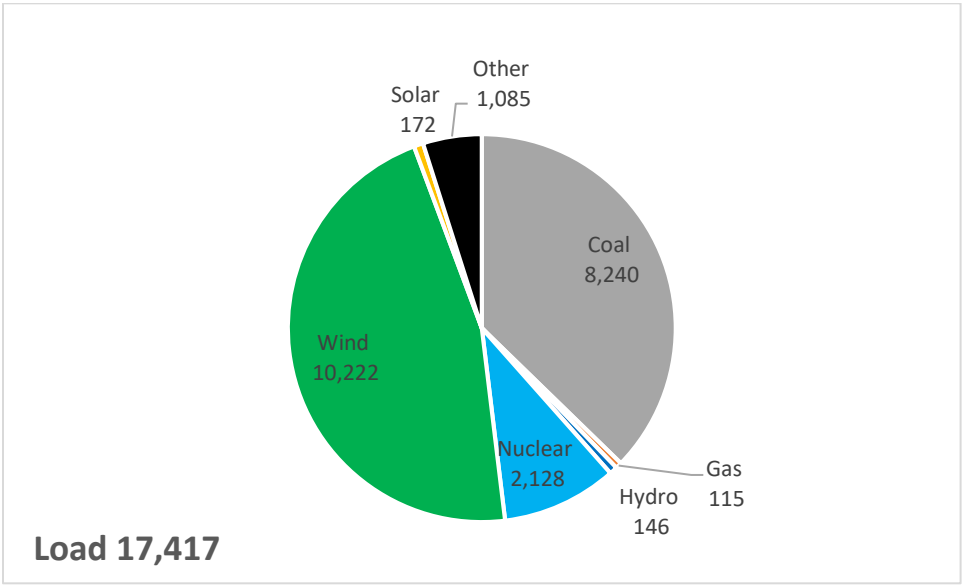




Wind generation is high and load is a moderate morning peak. The biggest constraints is:
(A) Cleveland to Le Center 69 kV in the event of an outage of Wilmarth to Sheas Lake 345 kV

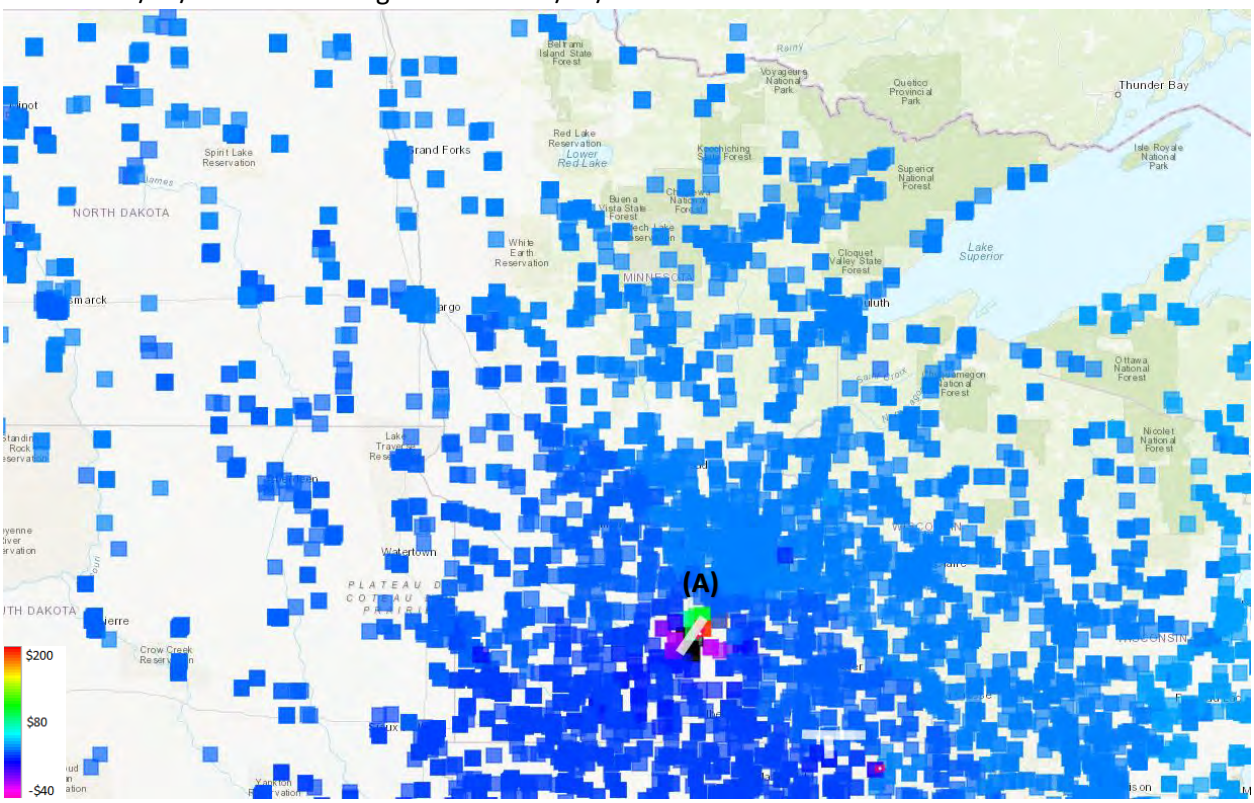
Week of 10/10/2022 Most congested hour 10/13/2022 11:00

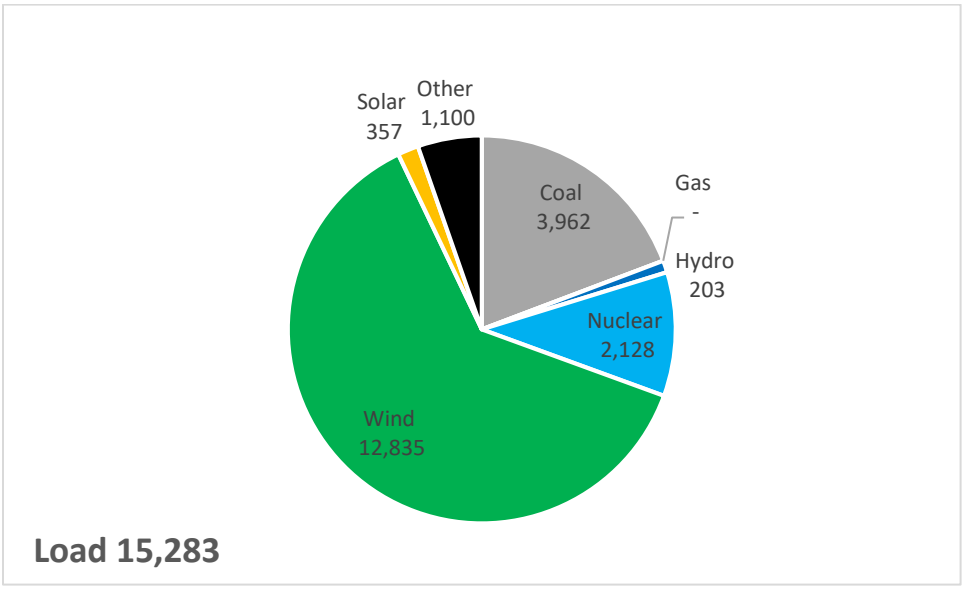




Wind generation is high and load is a moderate morning peak. The biggest constraints are:
(B) Hibbard to Winter Street 115 kV in the event of an outage of Arrowhead to Stone Lake 345 kV(managed by the Stinson phase shifting transformer, which the analytical tool is unable to model)
(E) Split Rock to White 345 kV in the event of an outage of Hawks Nest to Lyon Co 345 kV
(F) Ellendale to Aberdeen Jct 115 kV in the event of an outage of Twin Brooks-Big Stone South 345 kV

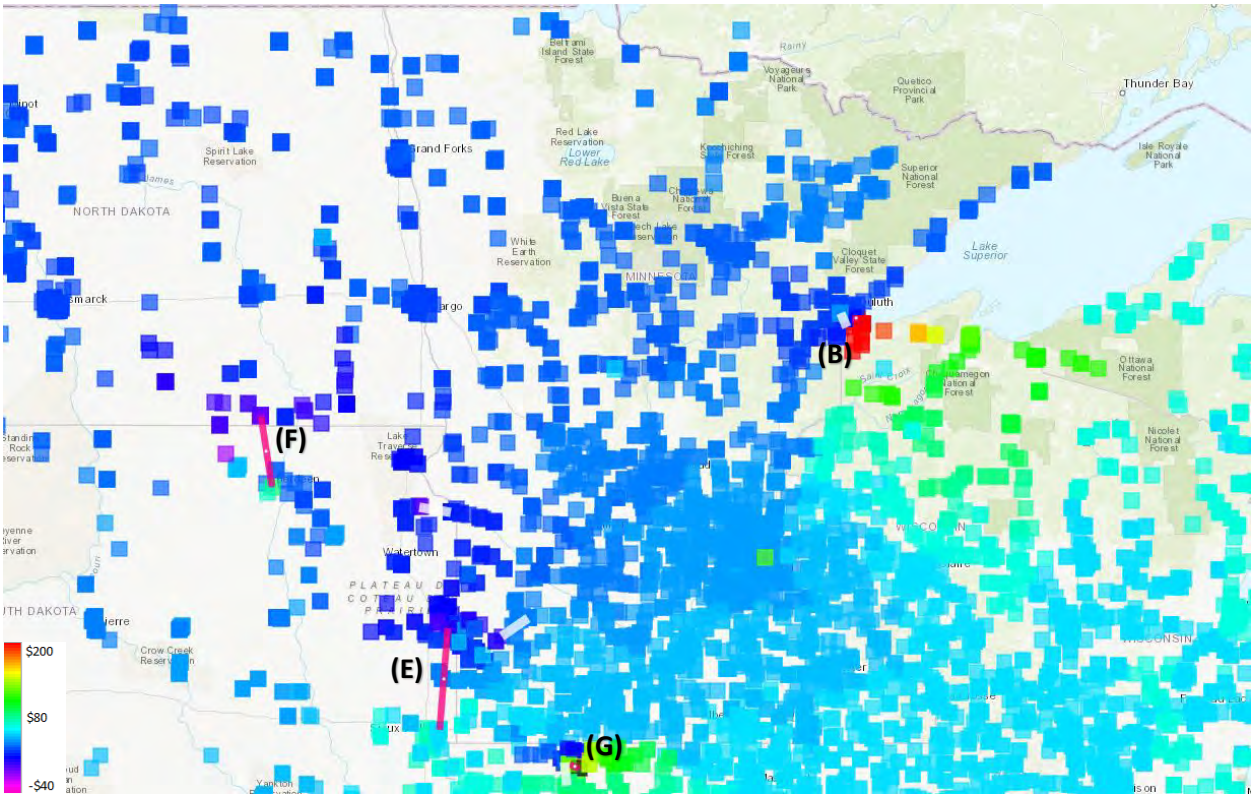
Week of 10/17/2022 Most congested hour 10/23/2022 14:00

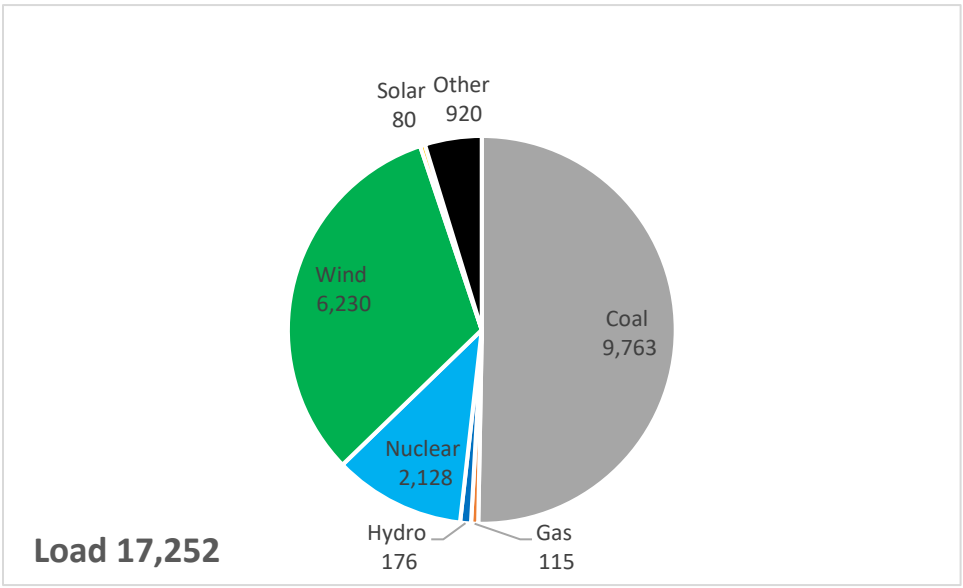




Wind generation is high and load is a low afternoon load. The biggest constraint is:
(A) Cleveland to Le Center 69 kV in the event of an outage of Wilmarth to Sheas Lake 345 kV

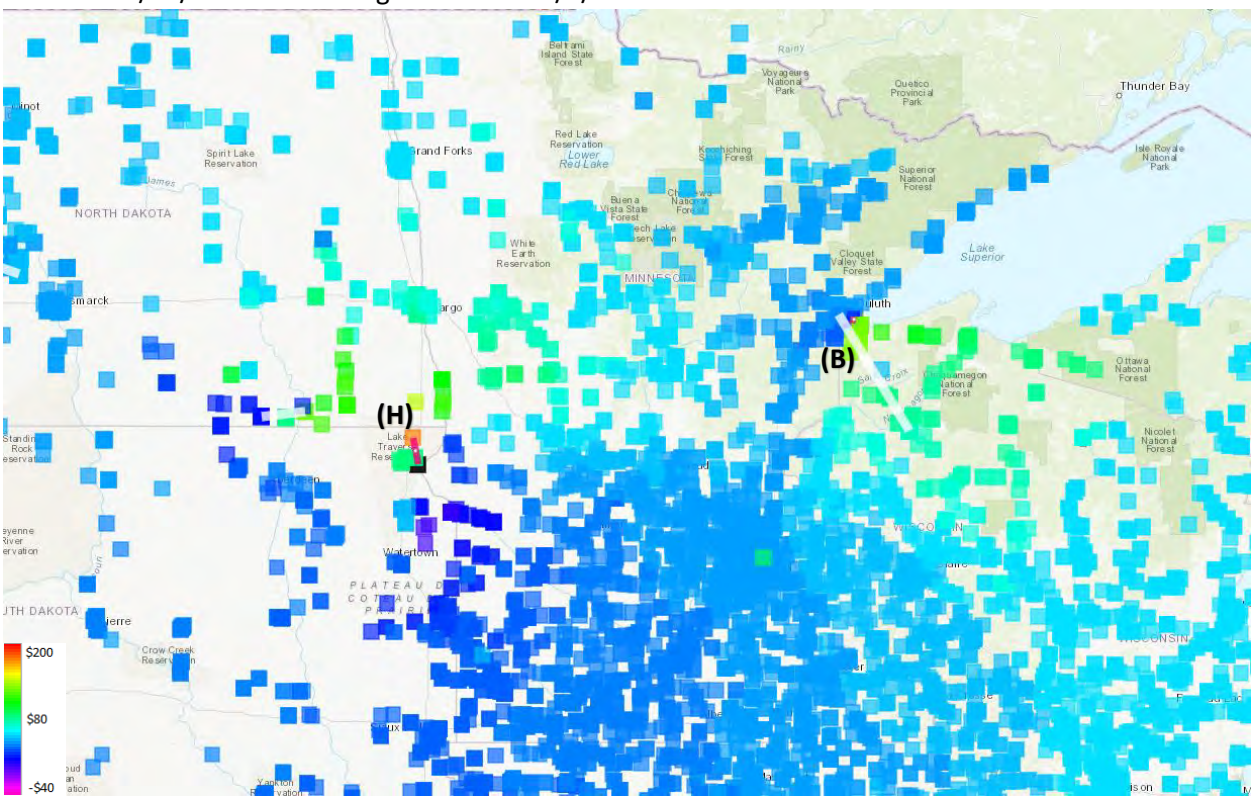
Week of 10/24/2022 Most congested hour 10/30/2022 19:00

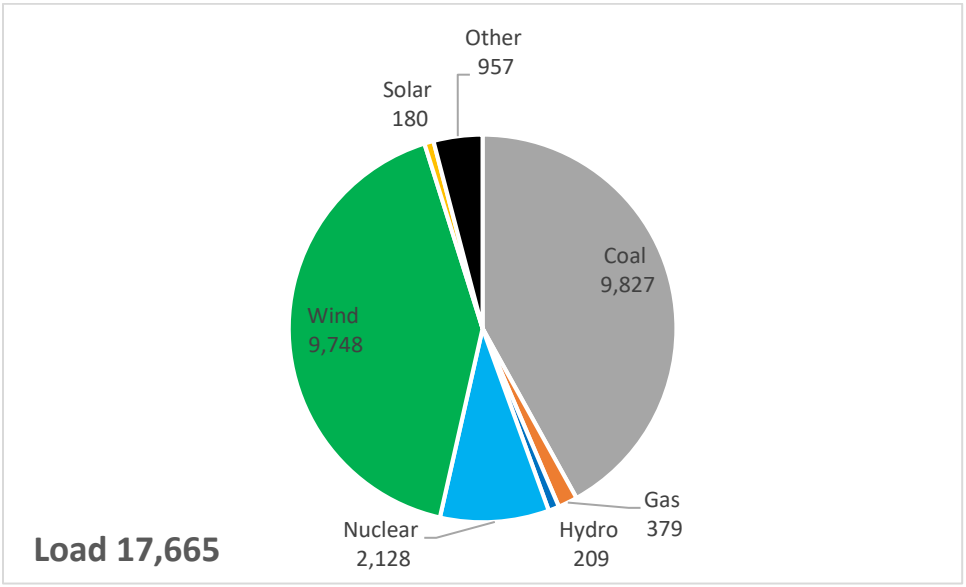




Wind generation is moderate and load is a moderate evening peak. The biggest constraints are:
(B) Hibbard to Winter Street 115 kV in the event of an outage of Arrowhead to Gary 115 kV (managed by the Stinson phase shifting transformer, which the analytical tool is unable to model)
(E) Split Rock to White 345 kV in the event of an outage of Hawks Nest to Lyon Co 345 kV
(F) Ellendale to Aberdeen Jct 115 kV in the event of an outage of Twin Brooks-Big Stone South 345 kV
(G) Pelican to Range 69 kV in the event of an outage of Cayler to Wisdom 161 kV

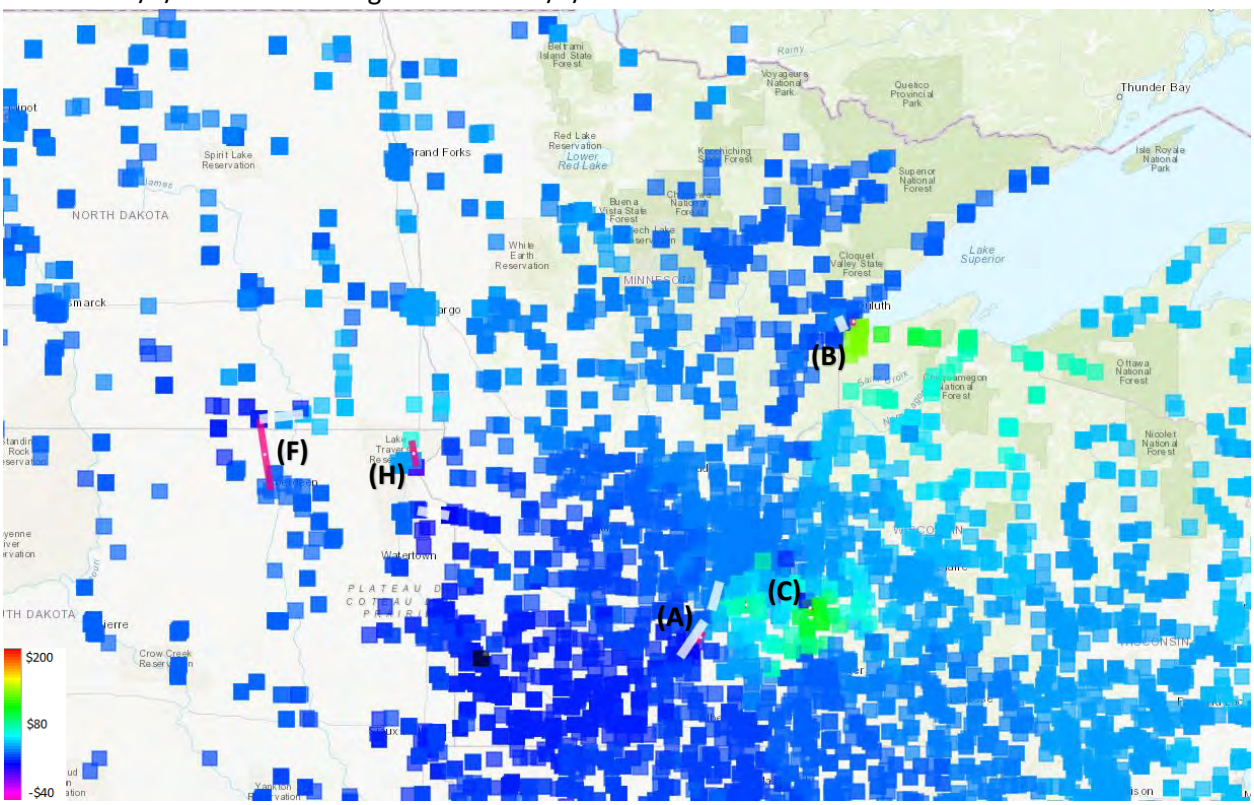
Week of 10/31/2022 Most congested hour 11/1/2022 15:00

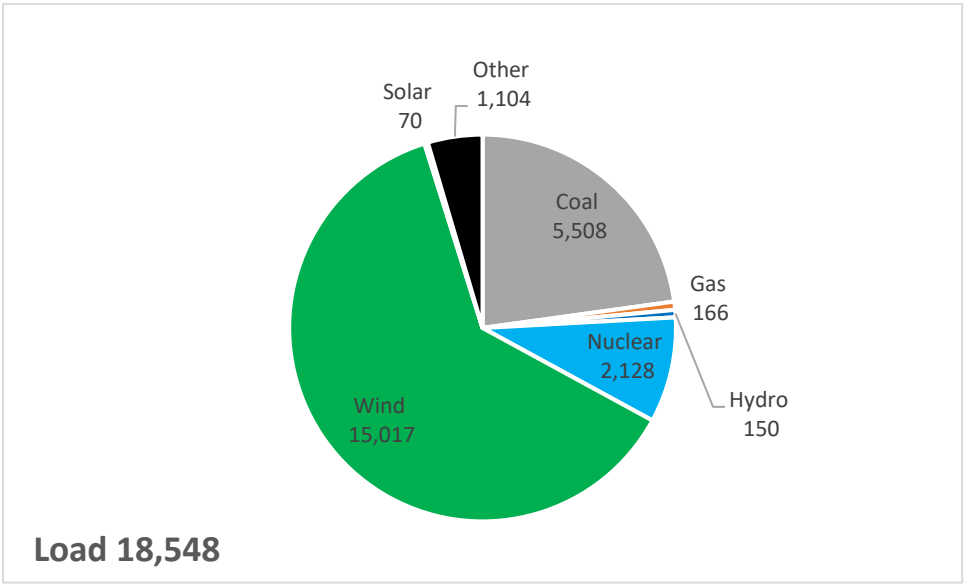




Wind generation is moderate and load is a moderate afternoon load. The biggest constraints are:
(B) Hibbard to Winter Street 115 kV in the event of an outage of Arrowhead to Stone Lake 345 kV (managed by the Stinson phase shifting transformer, which the analytical tool is unable to model)
(H) Browns Valley to New Effington 230 kV in the event of an outage of Oakes to Ellendale 230 kV

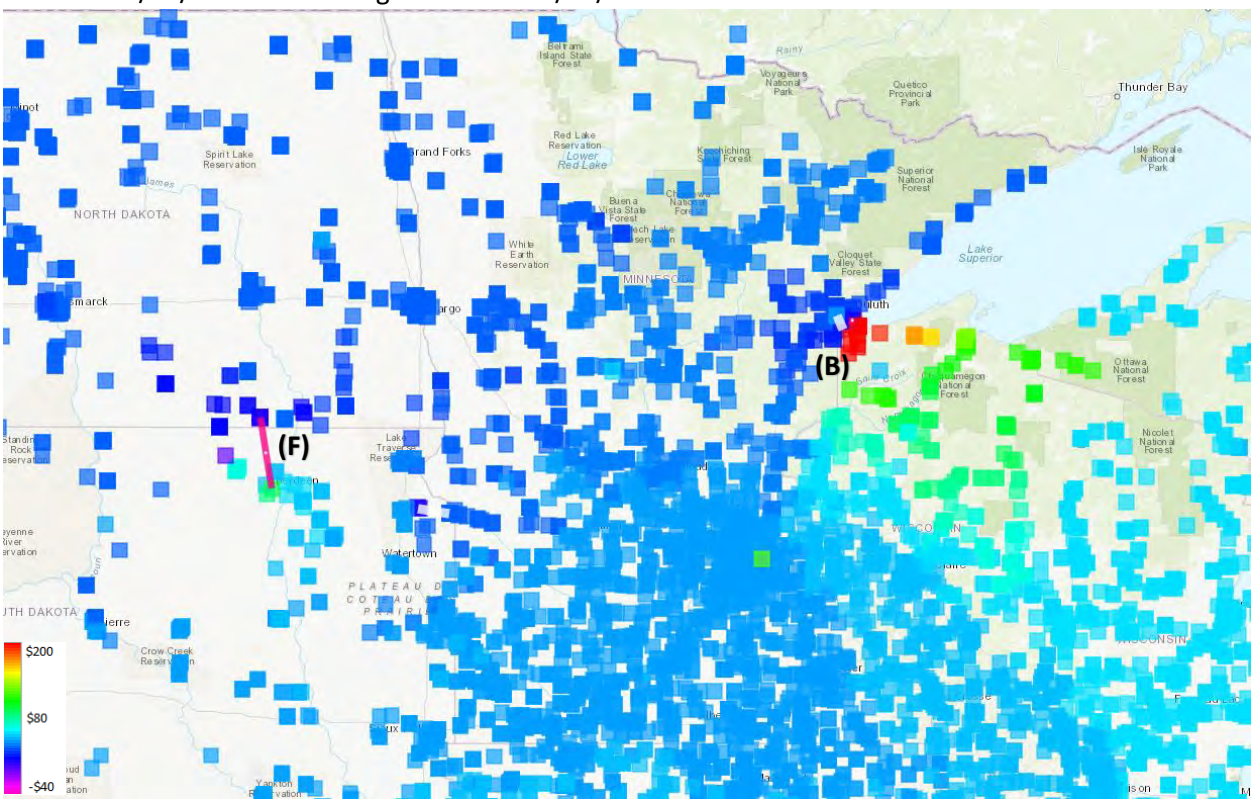
Week of 11/7/2022 Most congested hour 11/9/2022 8:00

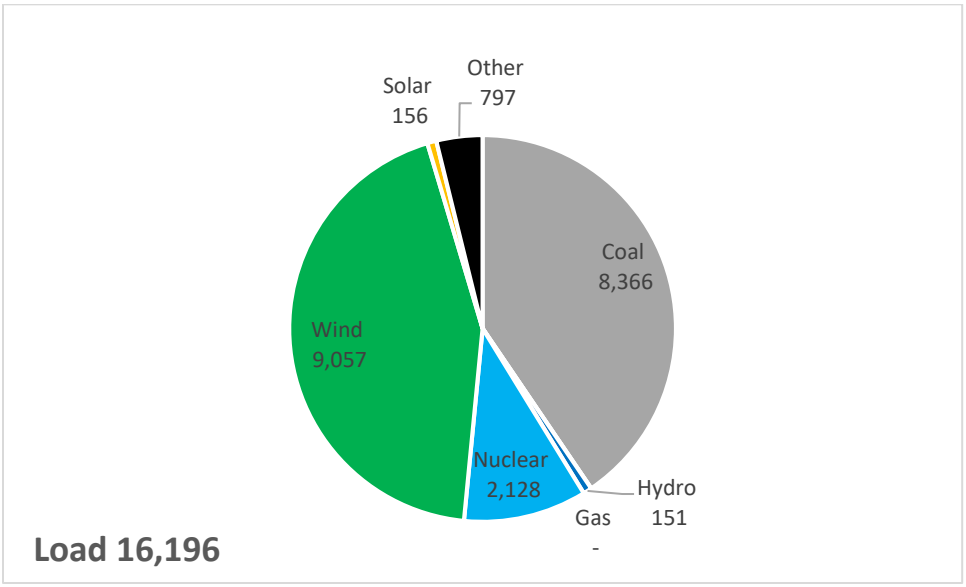




Wind generation is high and load is a moderate morning peak. The biggest constraints are:
(A) Cleveland to Le Center 69 kV in the event of an outage of Wilmarth to Sheas Lake 345 kV
(B) Hibbard to Winter Street 115 kV in the event of an outage of Arrowhead to Gary 115 kV (managed by the Stinson phase shifting transformer, which the analytical tool is unable to model)(C) Chub Lake 345/115 kV transformer in the event of an outage of Helena to Scott County 345 kV (being addressed in MTEP process)
(F) Ellendale to Aberdeen Jct 115 kV in the event of an outage of Twin Brooks-Big Stone South 345 kV
(H) Browns Valley to New Effington 230 kV in the event of an outage of Oakes to Ellendale 230 kV.

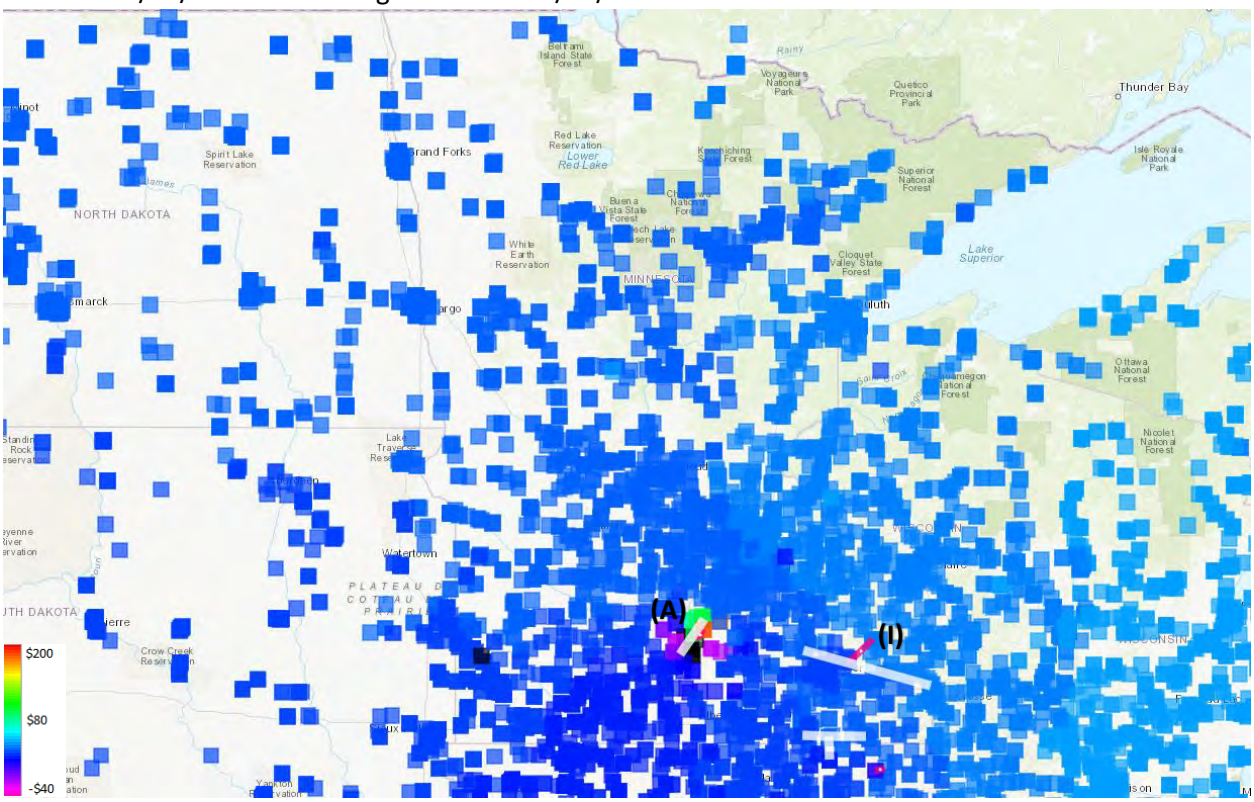
Week of 11/14/2022 Most congested hour 11/18/2022 11:00

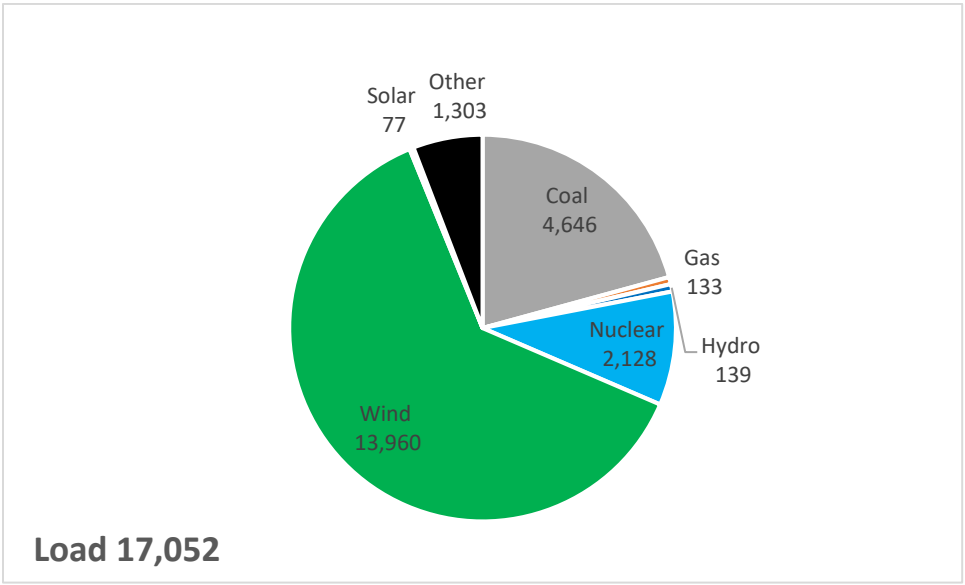




Wind generation is moderate and load is a low morning load. The biggest constraints are:
(B) Hibbard to Winter Street 115 kV in the event of an outage of Arrowhead to Gary 115 kV (managed by the Stinson phase shifting transformer, which the analytical tool is unable to model)
(F) Ellendale to Aberdeen Jct 115 kV in the event of an outage of Twin Brooks-Big Stone South 345 kV

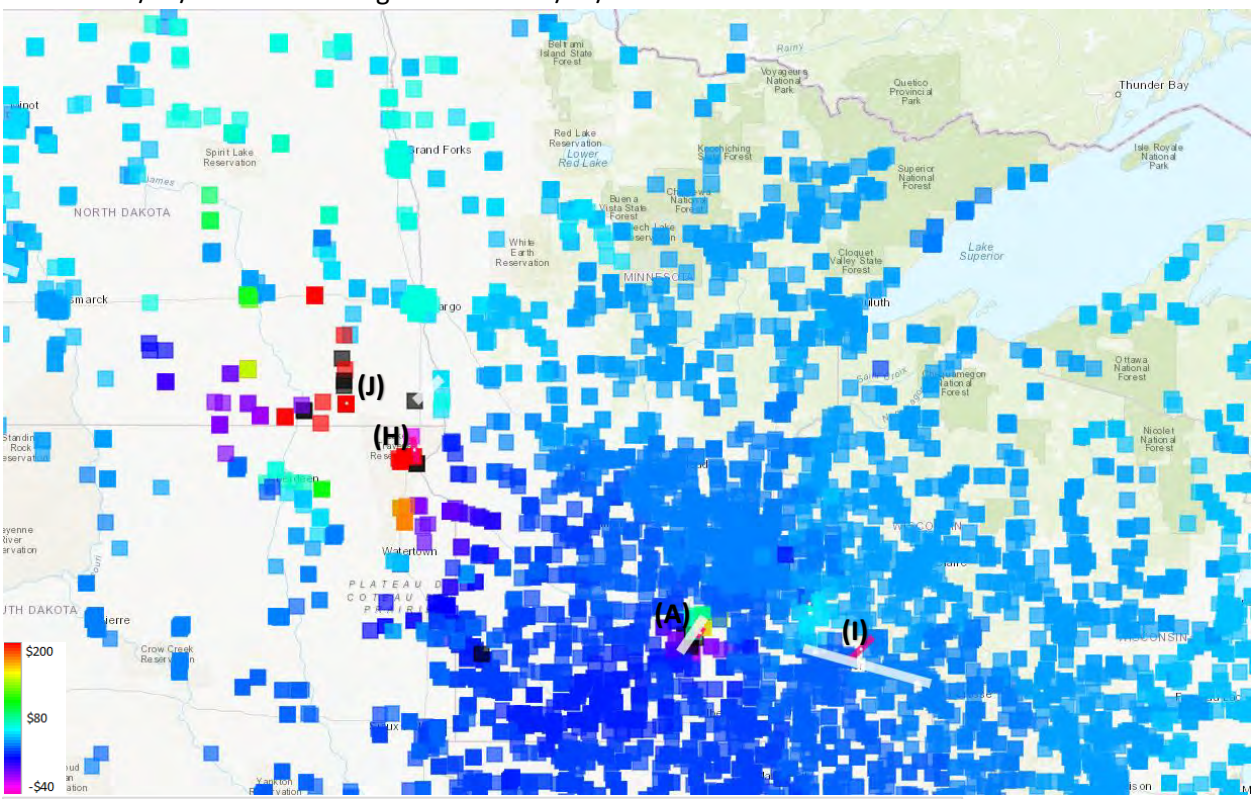
Week of 11/21/2022 Most congested hour 11/26/2022 9:00

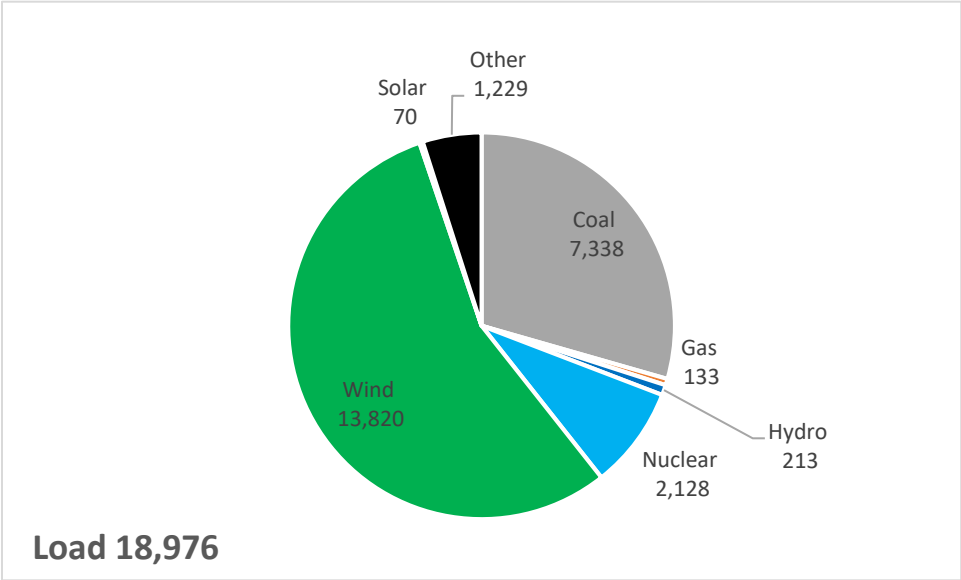




Wind generation is high and load is a moderate morning peak. The biggest constraints are:
(A) Cleveland to Le Center 69 kV in the event of an outage of Wilmarth to Sheas Lake 345 kV
(I) Wabaco to Alma 161 kV in the event of an outage of North Rochester to Briggs Road 345 kV

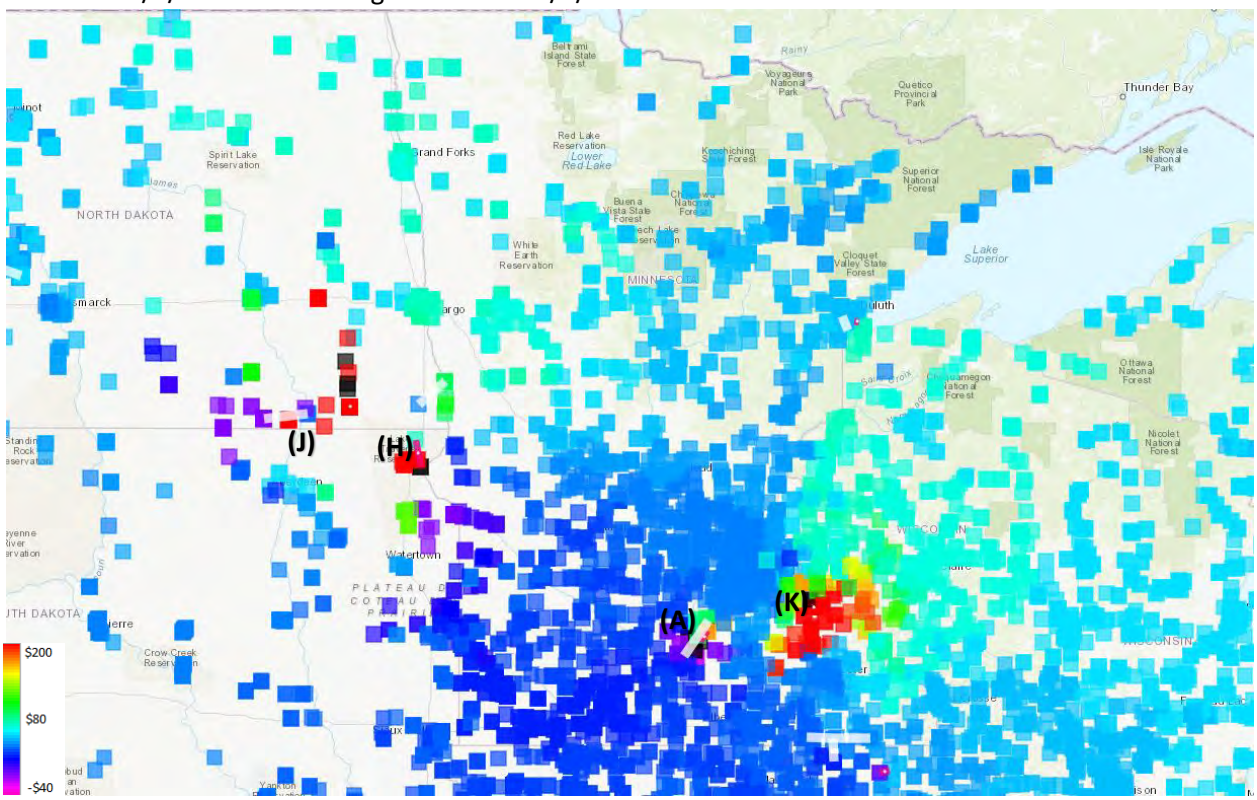
Week of 11/28/2022 Most congested hour 11/28/2022 19:00

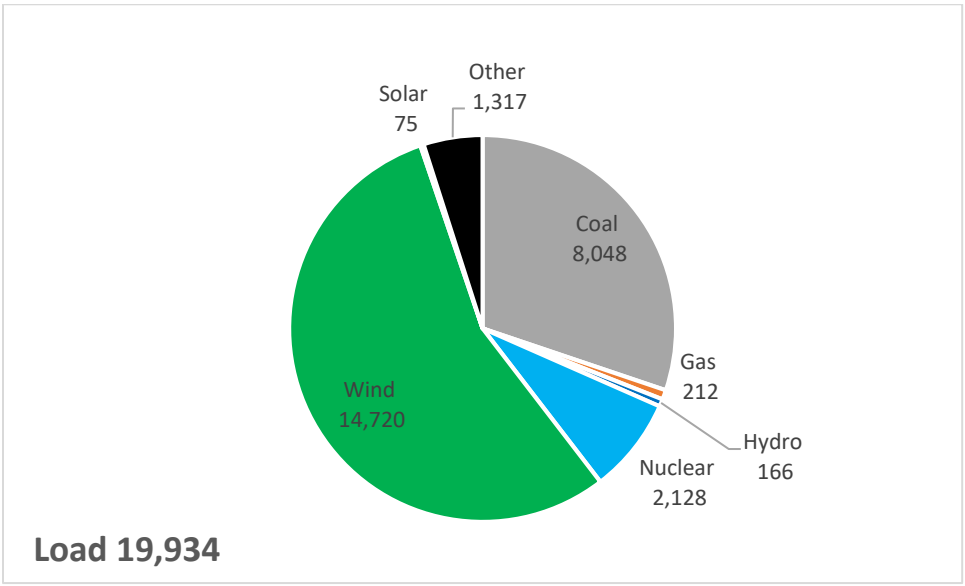




Wind generation is high and load is a moderate evening peak. The biggest constraints are:
(A) Cleveland to Le Center 69 kV in the event of an outage of Wilmarth to Sheas Lake 345 kV
(H) Browns Valley to New Effington 230 kV in the event of an outage of Ellendale 345/230 kV transformer
(I) Wabaco to Alma 161 kV in the event of an outage of North Rochester to Briggs Road 345 kV
(J) Forman 345/115 kV transformer in the event of an outage of Hankinson to Wahpeton 230 kV

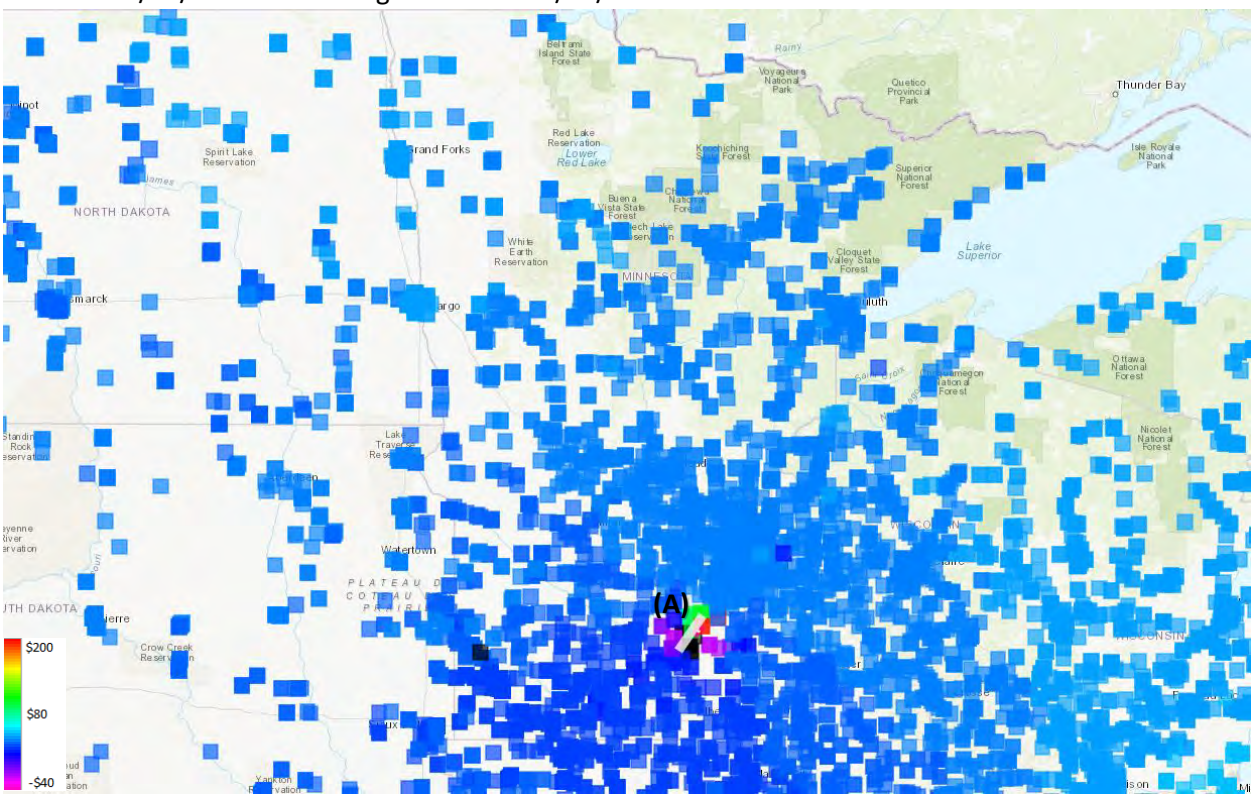
Week of 12/5/2022 Most congested hour 12/5/2022 9:00

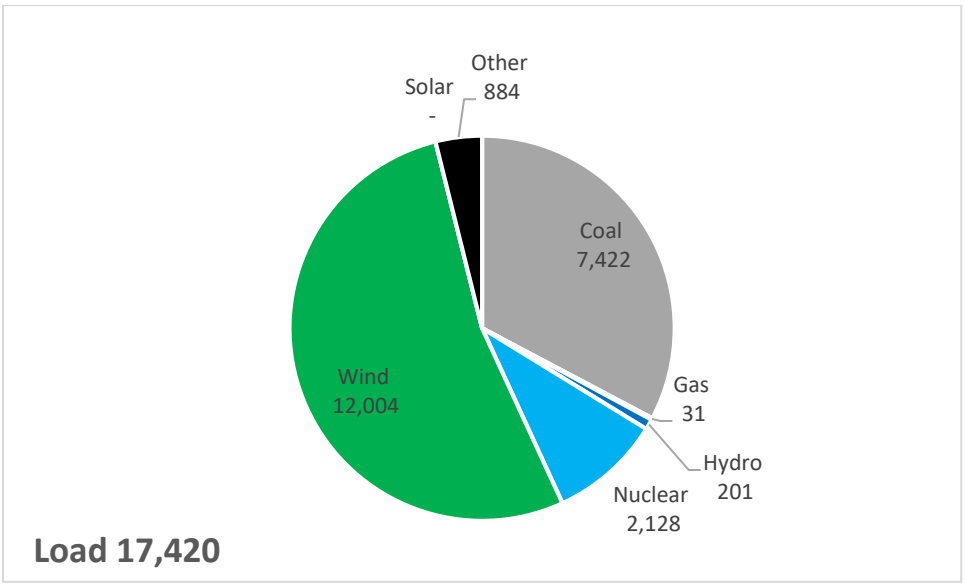




Wind generation is high and load is a high morning peak. The biggest constraints are:
(A) Cleveland to Le Center 69 kV in the event of an outage of Wilmarth to Sheas Lake 345 kV
(H) Browns Valley to New Effington 230 kV in the event of an outage of Ellendale to Oakes 230 kV
(J) Forman 345/115 kV transformer in the event of an outage of Hankinson to Wahpeton 230 kV
(K) Spring Creek 161/69 kV transformer in the event of an outage of Spring Creek parallel transformer

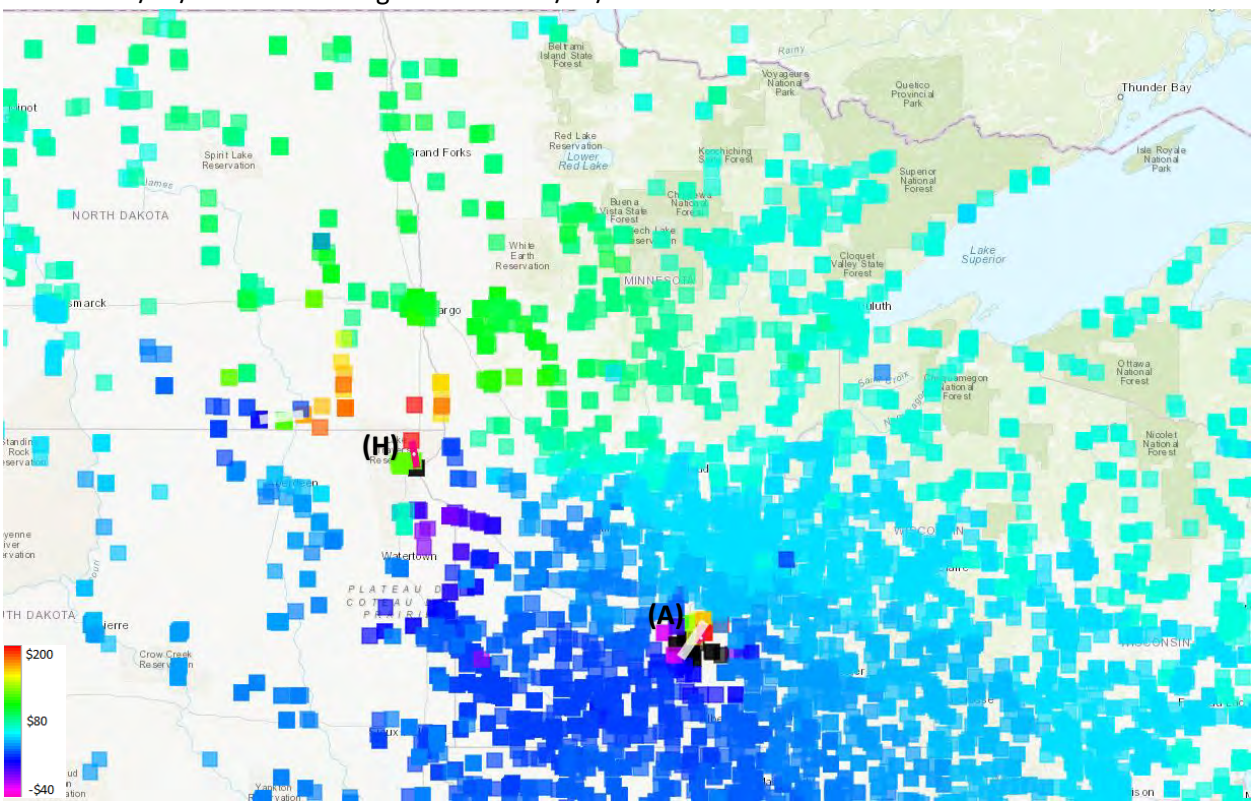
Week of 12/12/2022 Most congested hour 12/13/2022 23:00

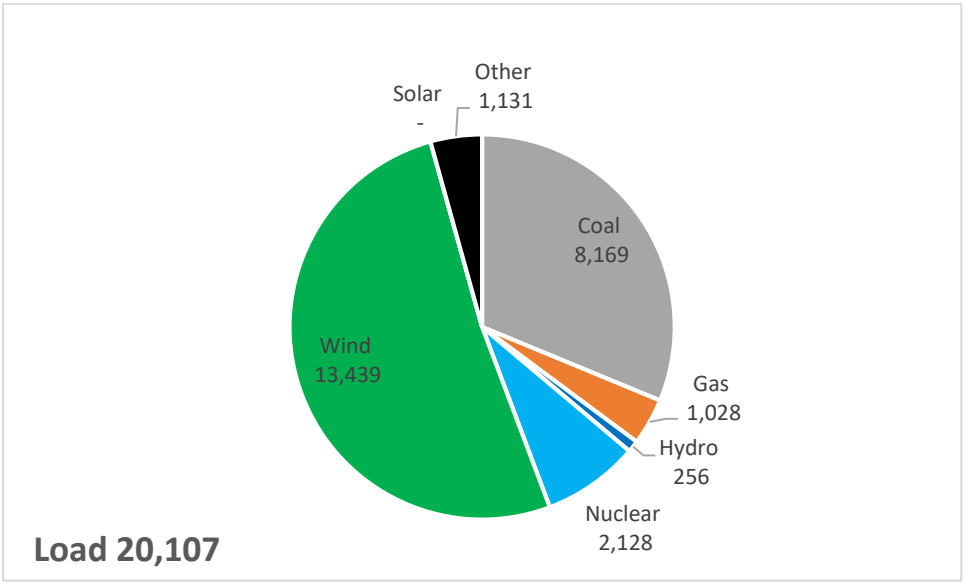




Wind generation is high and load is a moderate night load. The biggest constraint is:
(A) Cleveland to Le Center 69 kV in the event of an outage of Wilmarth to Sheas Lake 345 kV.

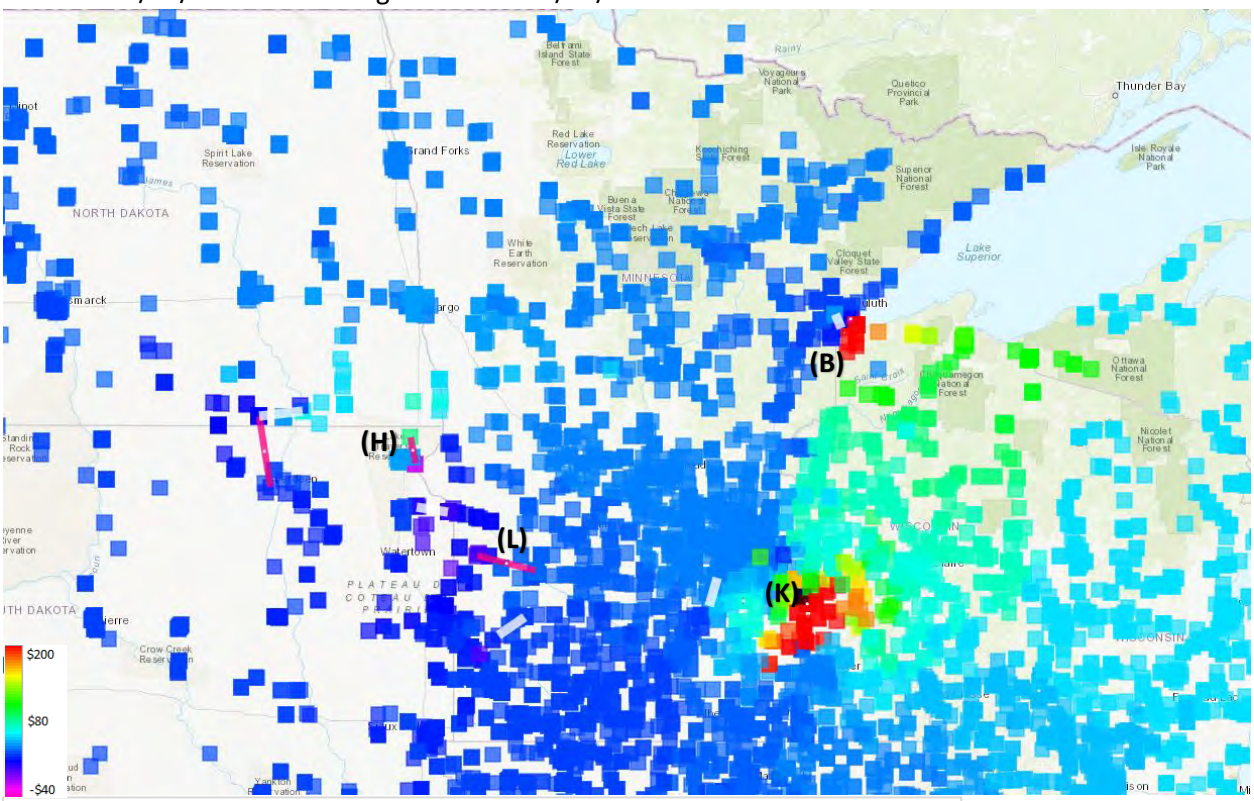
Week of 12/19/2022 Most congested hour 12/23/2022 18:00

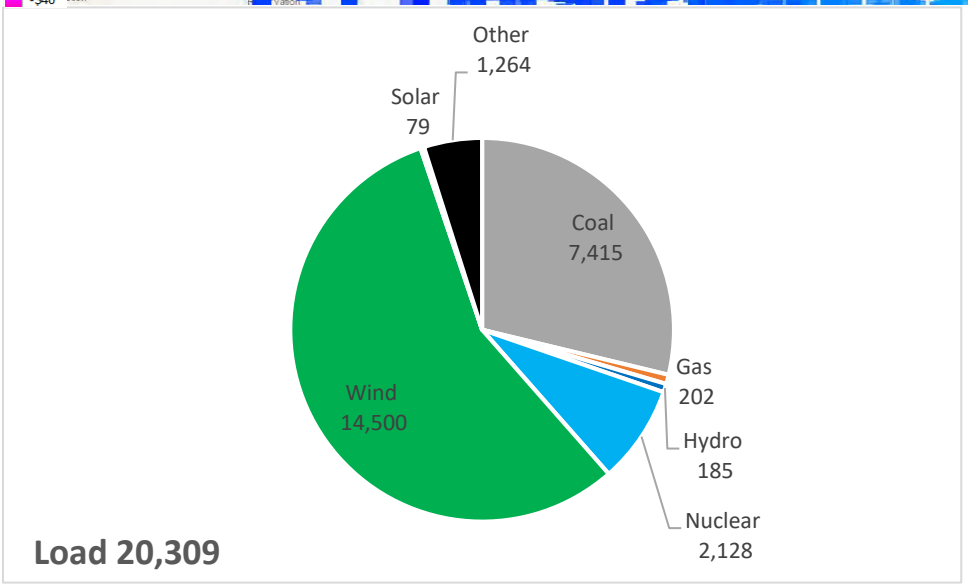




Wind generation is high and load is a high evening peak. The biggest constraints are:
(A) Cleveland to Le Center 69 kV in the event of an outage of Wilmarth to Sheas Lake 345 kV
(H) Browns Valley to New Effington 230 kV in the event of an outage of Ellendale to Oakes 230 kV

Week of 12/26/2022 Most congested hour 12/30/2022 19:00





Wind generation is high and load is a high evening peak. The biggest constraints are:
(H) Browns Valley to New Effington 230 kV in the event of an outage of Ellendale to Oakes 230 kV
(K) Spring Creek 161/69 kV transformer in the event of an outage of Spring Creek parallel transformer
(L) Granite Falls to Blair 230 kV in the event of an outage of Twin Brooks to Big Stone South 345 kV

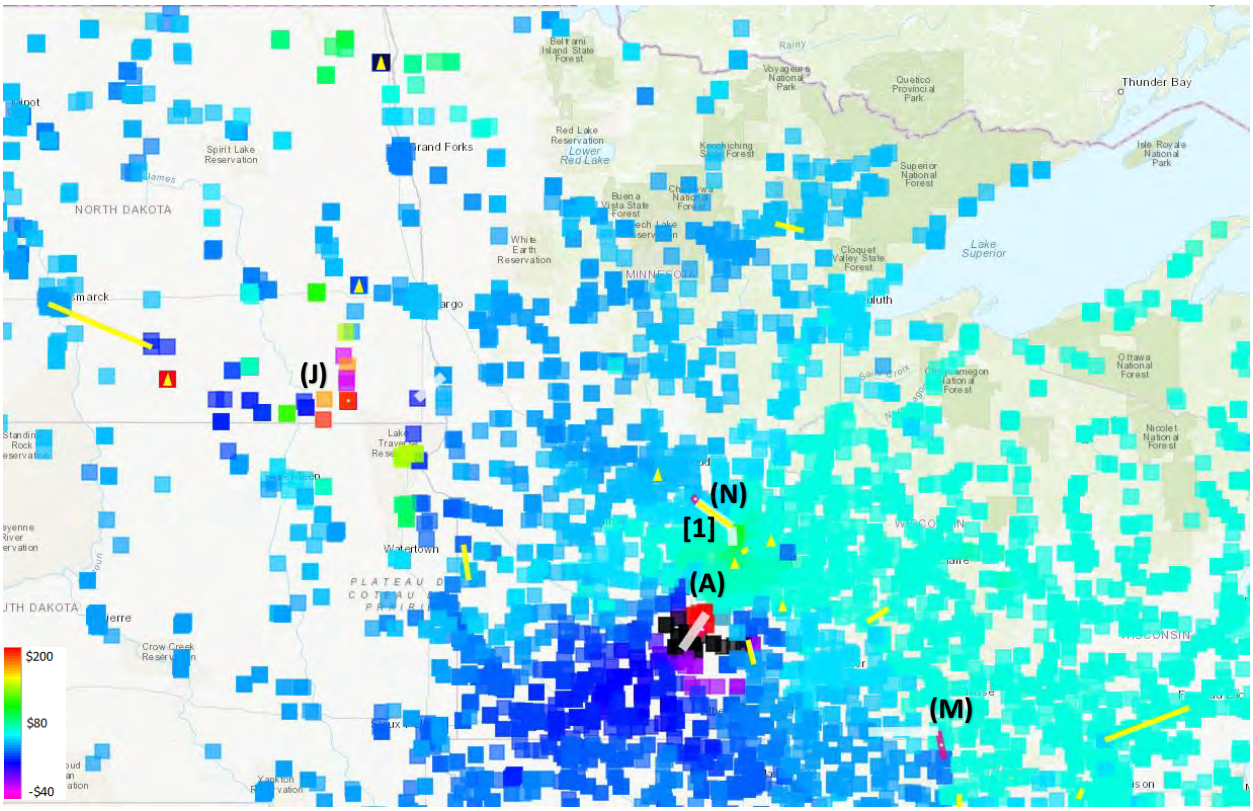
Planned Outage from CROW Operating State

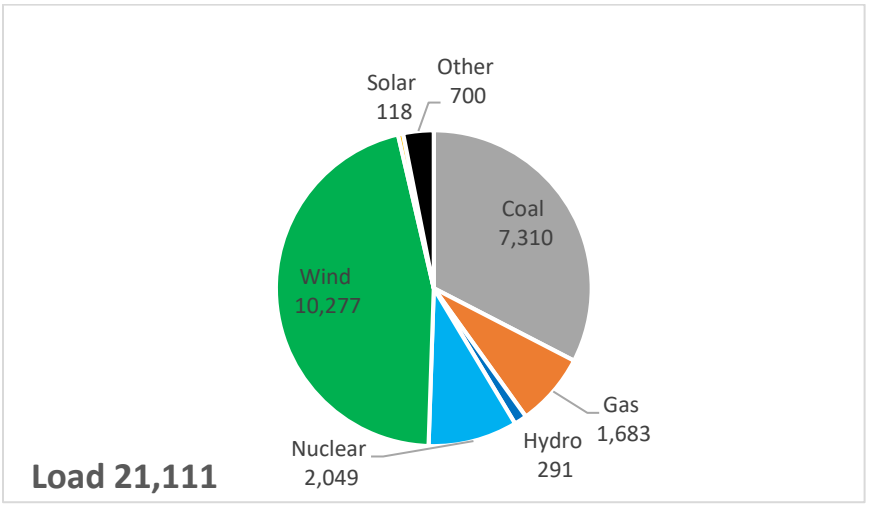
Weekly summary table of congestion and generation fuel mix in the study footprint for planned outage operating state.

Week Of	Hours Congested	Shadow Sum	Top 3 constraints for the week	Coal	Gas	Hydro	Nuclear	Wind	Solar	Other	Load	Worst Hour
8/29/2022	153	$77,311	[$58,409] GRE-CLVLAND8 to LECENTR8 #1 [$8,990] FORMN 7 to FORMAN 7 #1 [$2,454] GRE-SPRGCK15 to YBUS(GRE-SPRNGCK8,GRE-SPRNGC1T) #1	1,076,920	125,879	31,550	344,180	1,208,913	17,617	125,901	2,825,102	8/30/2022 10:00
9/5/2022	168	$17,092	[$5,799] ABDNJCT7 to ELLENDL7 #1 [$3,302] MNTCELO3 to SHERCO 3 #1 [$3,134] FORMN 7 to FORMAN 7 #1	1,251,039	309,326	30,725	344,180	974,635	16,191	102,960	3,117,422	9/5/2022 8:00
9/12/2022	167	$77,580	[$20,929] GRE-CLVLAND8 to LECENTR8 #1 [$18,984] HIBBARD7 to WNTR ST7 #1 [$13,038] FORMN 7 to FORMAN 7 #1	1,066,359	146,814	30,746	344,180	1,288,461	24,146	149,601	2,788,925	9/16/2022 7:00
9/19/2022	168	$49,526	[$14,295] FORMN 7 to FORMAN 7 #1 [$8,598] HOOT LK7 to FERGSFL7 #1 [$7,291] GRE-CLVLAND8 to LECENTR8 #1	1,140,759	109,898	29,932	344,180	1,204,348	18,491	132,471	2,660,315	9/23/2022 9:00
9/26/2022	133	$28,386	[$5,083] FORMN 7 to FORMAN 7 #1 [$5,051] HIBBARD7 to WNTR ST7 #1 [$4,115] GRE-CLVLAND8 to LECENTR8 #1	1,284,254	54,501	31,616	357,462	1,158,640	16,305	130,443	2,706,386	9/30/2022 7:00
10/3/2022	120	$32,944	[$14,532] GRE-SPRGCK15 to YBUS(GRE-SPRNGCK8,GRE-SPRNGC1T) #1 [$10,285] GRE-CLVLAND8 to LECENTR8 #1 [$2,723] BROWNSV4 to NEW EFFNGTN4 #1	1,488,593	54,931	34,497	357,462	933,516	11,596	109,884	2,730,248	10/6/2022 7:00
10/10/2022	150	$39,812	[$9,294] MINVALT4 to GRANITF4 #1 [$7,687] GRE-SPRGCK15 to YBUS(GRE-SPRNGCK8,GRE-SPRNGC1T) #1 [$7,109] ABDNJCT7 to ELLENDL7 #1	1,436,693	33,128	34,057	357,462	1,128,140	11,668	122,863	2,732,530	10/12/2022 19:00
10/17/2022	158	$83,467	[$28,686] HOOT LK7 to FERGSFL7 #1 [$13,420] ROSEAU 4 to MORANVI4 #1 [$9,483] ABDNJCT7 to ELLENDL7 #1	1,136,049	19,930	33,975	357,462	1,577,331	23,225	153,068	2,732,497	10/21/2022 20:00
10/24/2022	161	$43,803	[$11,421] HOOT LK7 to FERGSFL7 #1 [$9,352] ABDNJCT7 to ELLENDL7 #1 [$7,436] HIBBARD7 to WNTR ST7 #1	1,580,965	30,789	33,958	357,462	931,462	15,467	116,141	2,754,787	10/24/2022 5:00
10/31/2022	165	$54,079	[$19,723] HOOT LK7 to FERGSFL7 #1 [$19,275] GRE-SPRGCK15 to YBUS(GRE-SPRNGCK8,GRE-SPRNGC1T) #1 [$4,450] BROWNSV4 to NEW EFFNGTN4 #1	1,528,918	125,097	35,742	357,462	1,000,867	12,749	118,559	2,854,835	10/31/2022 11:00
11/7/2022	158	$44,270	[$11,566] HIBBARD7 to WNTR ST7 #1 [$10,198] BROWNSV4 to NEW EFFNGTN4 #1 [$8,497] GRE-SPRGCK15 to YBUS(GRE-SPRNGCK8,GRE-SPRNGC1T) #1	1,469,551	84,304	36,982	357,462	1,287,247	12,343	128,539	2,904,752	11/9/2022 18:00
11/14/2022	152	$35,545	[$9,765] HIBBARD7 to WNTR ST7 #1 [$8,549] GRE-SPRGCK15 to YBUS(GRE-SPRNGCK8,GRE-SPRNGC1T) #1 [$6,936] ABDNJCT7 to ELLENDL7 #1	1,361,213	42,617	36,163	357,462	1,410,705	17,868	139,664	2,751,243	11/14/2022 8:00
11/21/2022	150	$47,340	[$24,994] GRE-SPRGCK15 to YBUS(GRE-SPRNGCK8,GRE-SPRNGC1T) #1 [$9,670] BROWNSV4 to NEW EFFNGTN4 #1 [$4,472] HIBBARD7 to WNTR ST7 #1	1,486,553	30,702	36,885	357,462	1,489,710	14,904	141,387	2,912,069	11/23/2022 15:00
11/28/2022	166	$55,288	[$17,451] GRE-CLVLAND8 to LECENTR8 #1 [$12,380] GRE-SPRGCK15 to YBUS(GRE-SPRNGCK8,GRE-SPRNGC1T) #1 [$10,510] BROWNSV4 to NEW EFFNGTN4 #1	1,513,467	168,096	34,705	357,462	1,347,623	12,886	138,459	3,070,232	11/28/2022 18:00
12/5/2022	168	$32,604	[$9,491] BROWNSV4 to NEW EFFNGTN4 #1 [$9,405] GRE-CLVLAND8 to LECENTR8 #1 [$4,514] EAU CL 3 to YBUS(EAU CLA5,EAUCLAIRE9 9) #9	1,649,430	155,091	32,361	357,462	1,065,866	13,173	116,708	3,029,060	12/5/2022 8:00
12/12/2022	161	$26,921	[$5,627] ABDNJCT7 to ELLENDL7 #1 [$4,977] GRE-CLVLAND8 to LECENTR8 #1 [$3,856] HIBBARD7 to WNTR ST7 #1	1,611,874	95,605	32,101	357,462	1,087,263	11,401	110,549	2,988,923	12/13/2022 23:00
12/19/2022	155	$54,532	[$22,933] GRE-CLVLAND8 to LECENTR8 #1 [$8,491] BROWNSV4 to NEW EFFNGTN4 #1 [$8,326] FORMN 7 to FORMAN 7 #1	1,474,917	57,298	31,597	357,462	1,516,683	14,538	138,298	2,943,363	12/23/2022 18:00
12/26/2022	163	$53,710	[$15,455] BROWNSV4 to NEW EFFNGTN4 #1 [$11,238] GRE-CLVLAND8 to LECENTR8 #1 [$6,929] EAU CL 3 to YBUS(EAU CLA5,EAUCLAIRE9 9) #9	1,504,566	219,335	32,777	357,462	1,376,264	12,117	134,599	3,204,048	12/26/2022 9:00

Most congested hour maps

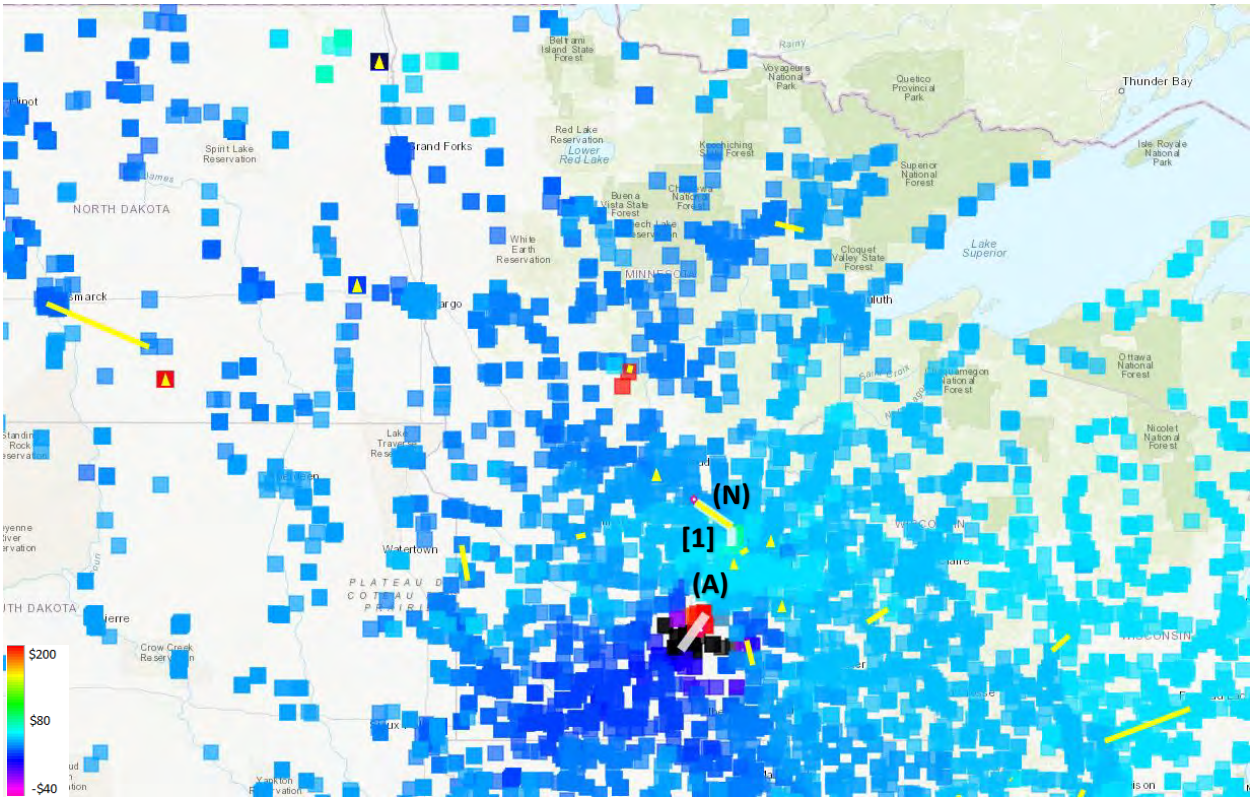
Week of 8/29/2022 Most congested hour 8/30/2022 10:00

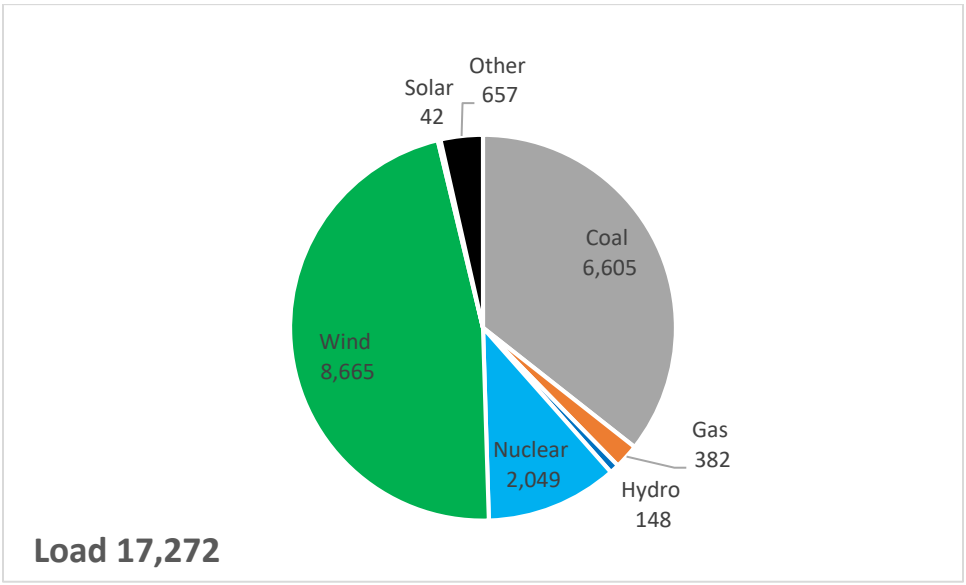




Wind generation is high and load is a high night load. The biggest constraints are:
(A) Cleveland to Le Center 69 kV in the event of an outage of Wilmarth to Sheas Lake 345 kV
(J) Forman 345/115 kV transformer in the event of an outage of Hankinson to Wahpeton 230 kV
(M) Lansing to Genoa 161 kV in the event of an outage of Genoa to Harmony 161 kV
(N) Monticello to Sherco 345 kV in the event of an outage of Elm Creek to Parkers Lake 345 kV
CROW Outages significantly impacting congestion:
[1] Elm Creek to Monticello 345 kV

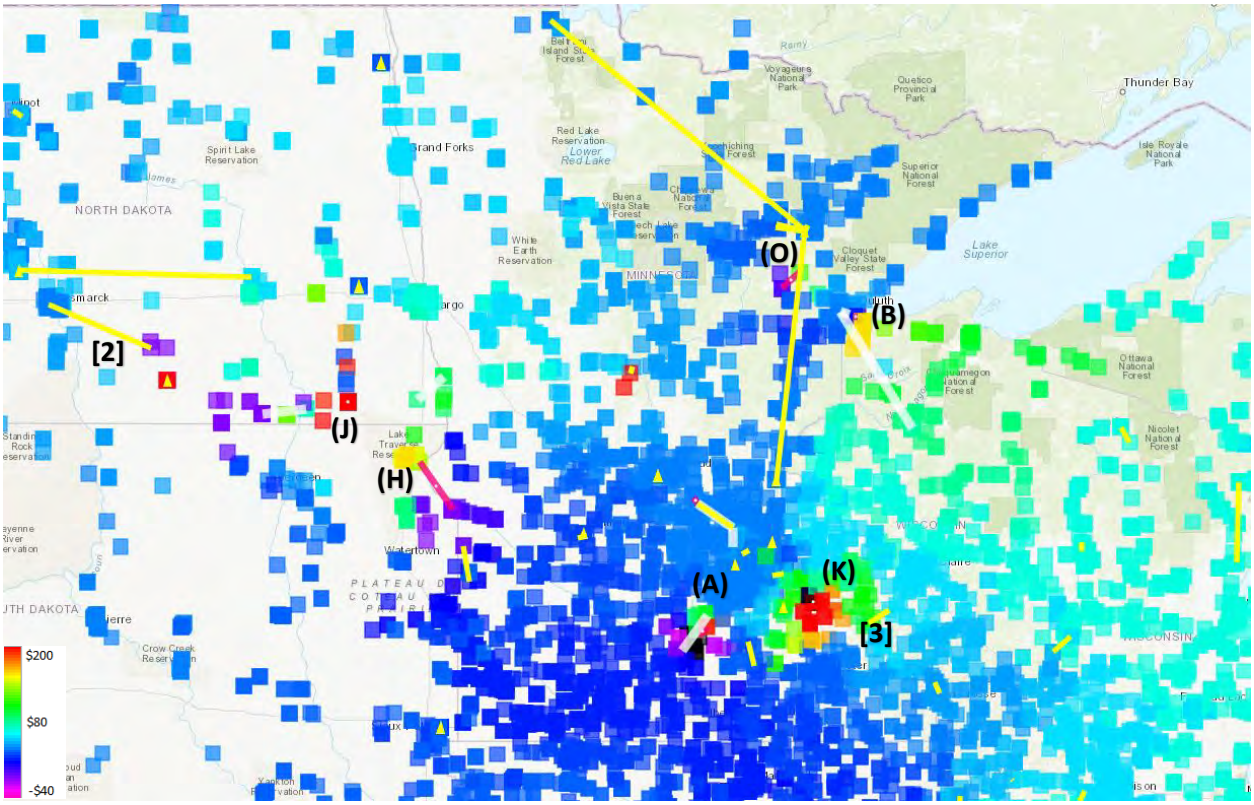
Week of 9/5/2022 Most congested hour 9/5/2022 8:00

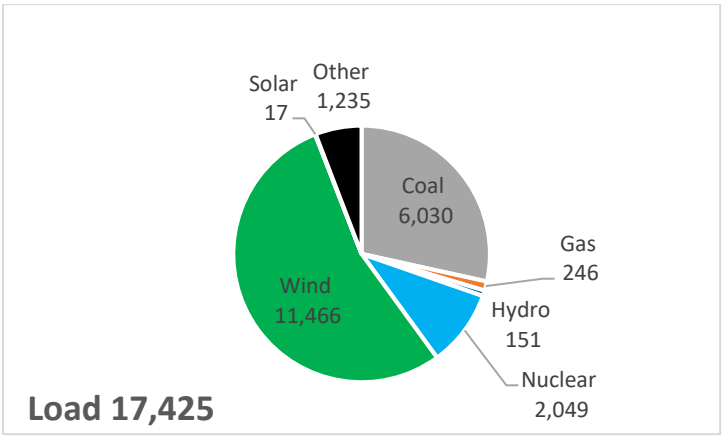




Wind generation is moderate and load is a moderate morning peak. The biggest constraints are:
(A) Cleveland to Le Center 69 kV in the event of an outage of Wilmarth to Sheas Lake 345 kV
(N) Monticello to Sherco 345 kV in the event of an outage of Elm Creek to Parkers Lake 345 kV
CROW Outages significantly impacting congestion:
[1] Elm Creek to Monticello 345 kV

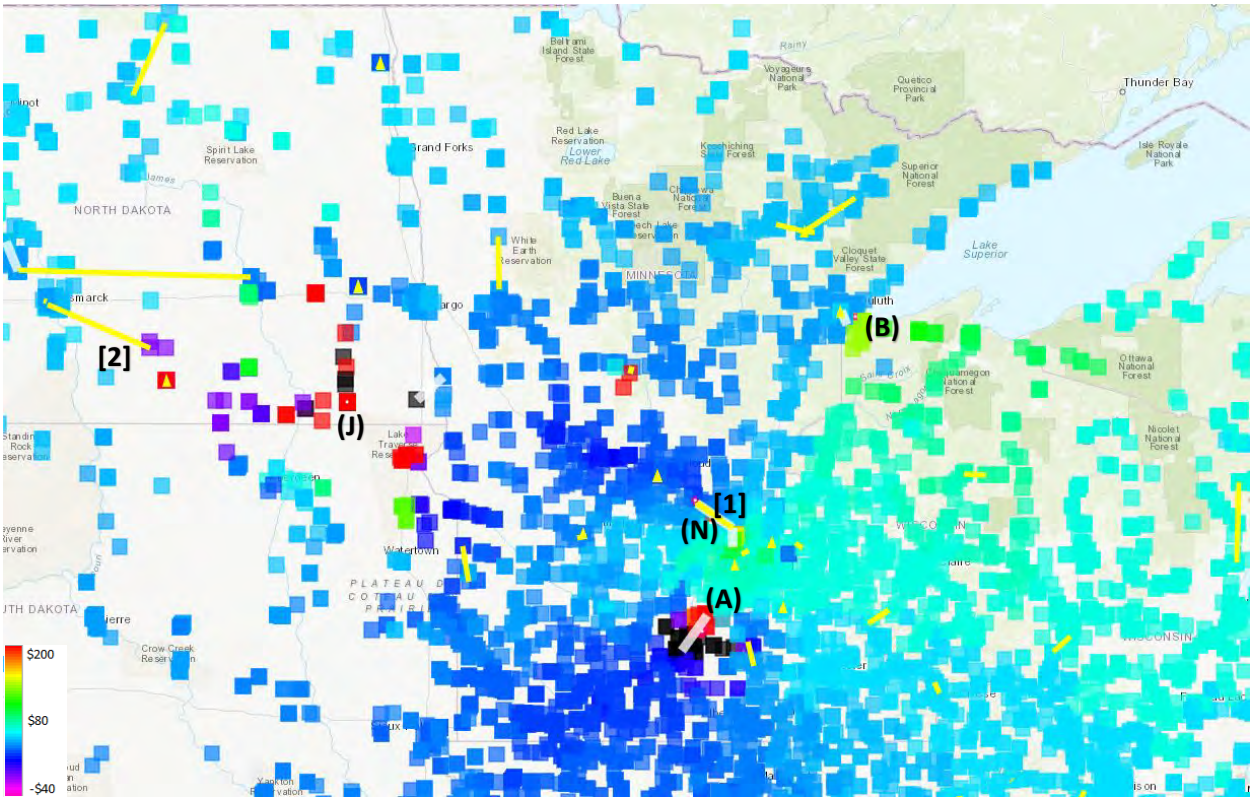
Week of 9/12/2022 Most congested hour 9/16/2022 7:00

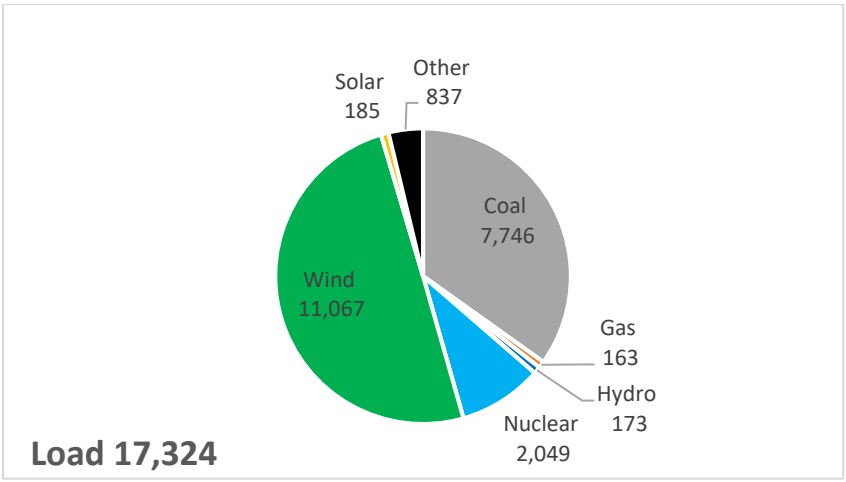




Wind generation is high and load is a moderate morning peak. The biggest constraints are:
(A) Cleveland to Le Center 69 kV in the event of an outage of Wilmarth to Sheas Lake 345 kV
(B) Hibbard to Winter Street 115 kV in the event of an outage of Arrowhead to Gary 115 kV (managed by the Stinson phase shifting transformer, which the analytical tool is unable to model)
(H) Browns Valley to Big Stone 230 kV in the event of an outage of Oakes to Ellendale 230 kV
(J) Forman 345/115 kV transformer in the event of an outage of Hankinson to Wahpeton 230 kV
(K) Spring Creek 161/69 kV transformer in the event of an outage of Spring Creek parallel transformer
(O) Floodwood Tap to Meadowlands 115 kV in the event of an outage of 98L Tap to Hilltop 230 kV
CROW Outages significantly impacting congestion:
[2] Mandan to Napoleon 230 kV
[3] Nelson to Gil Tap 69 kV

Week of 9/19/2022 Most congested hour 9/23/2022 9:00

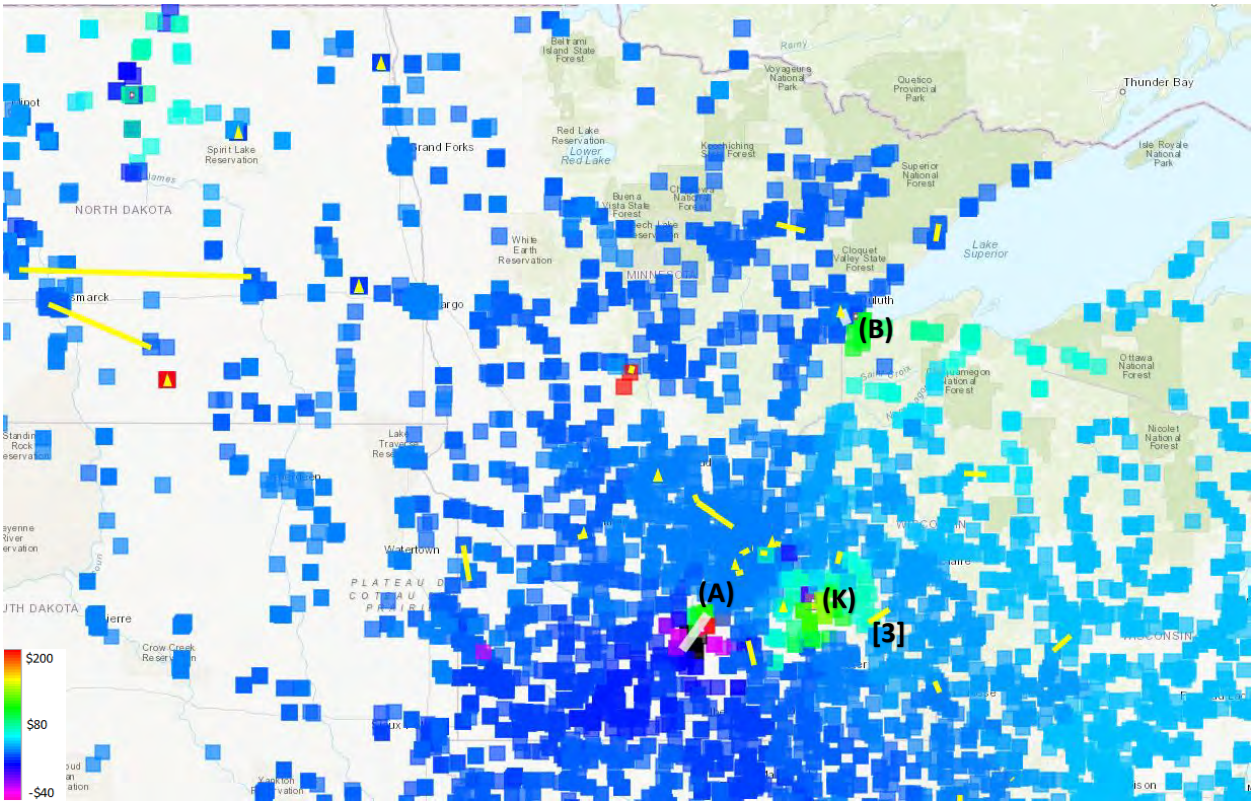


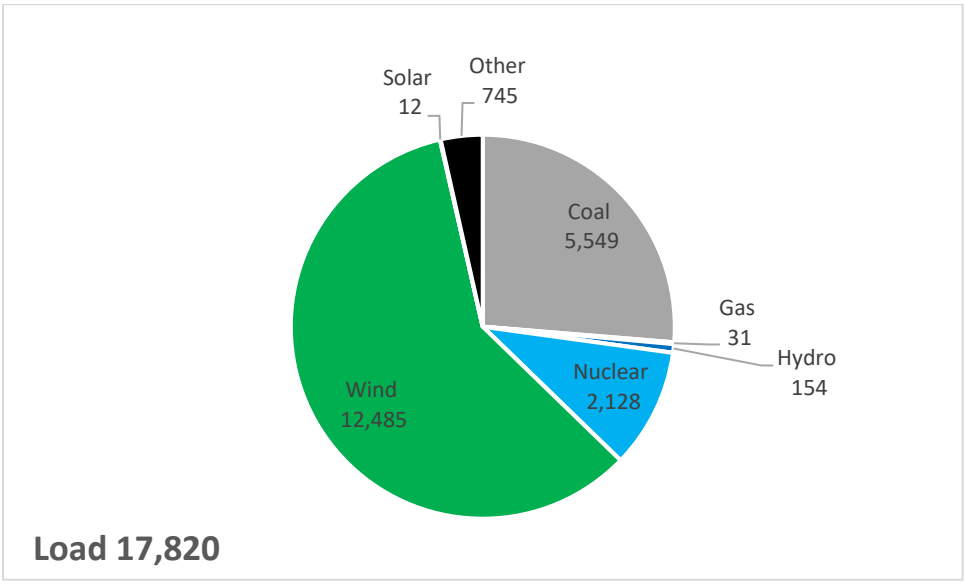


Wind generation is high and load is a moderate morning peak. The biggest constraints are:

(A) Cleveland to Le Center 69 kV in the event of an outage of Wilmarth to Sheas Lake 345 kV
(B) Hibbard to Winter Street 115 kV in the event of an outage of Arrowhead to Gary 115 kV (managed by the Stinson phase shifting transformer, which the analytical tool is unable to model)
(J) Forman 345/115 kV transformer in the event of an outage of Hankinson to Wahpeton 230 kV
(N) Monticello to Sherco 345 kV in the event of an outage of Elm Creek to Parkers Lake 345 kV
CROW Outages significantly impacting congestion:
[1] Elm Creek to Monticello 345 kV
[2] Mandan to Napoleon 230 kV

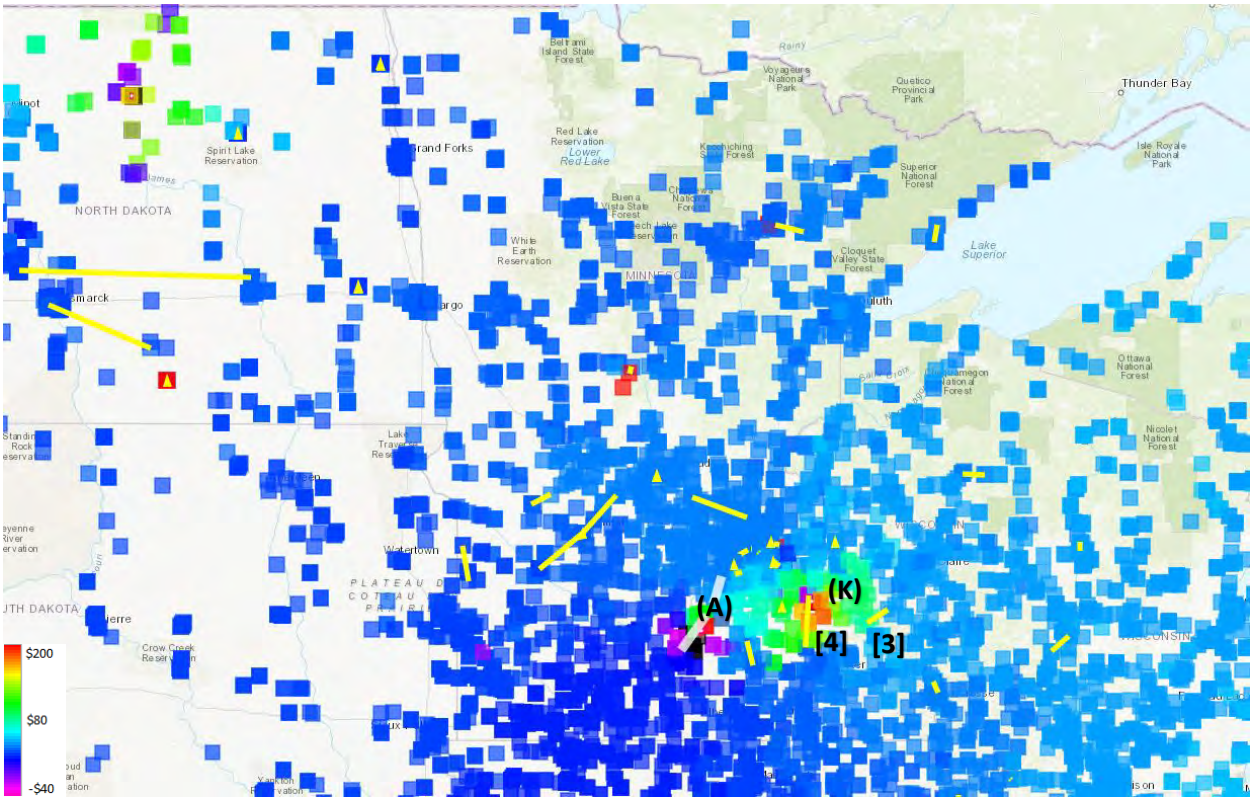
Week of 9/26/2022 Most congested hour 9/30/2022 7:00

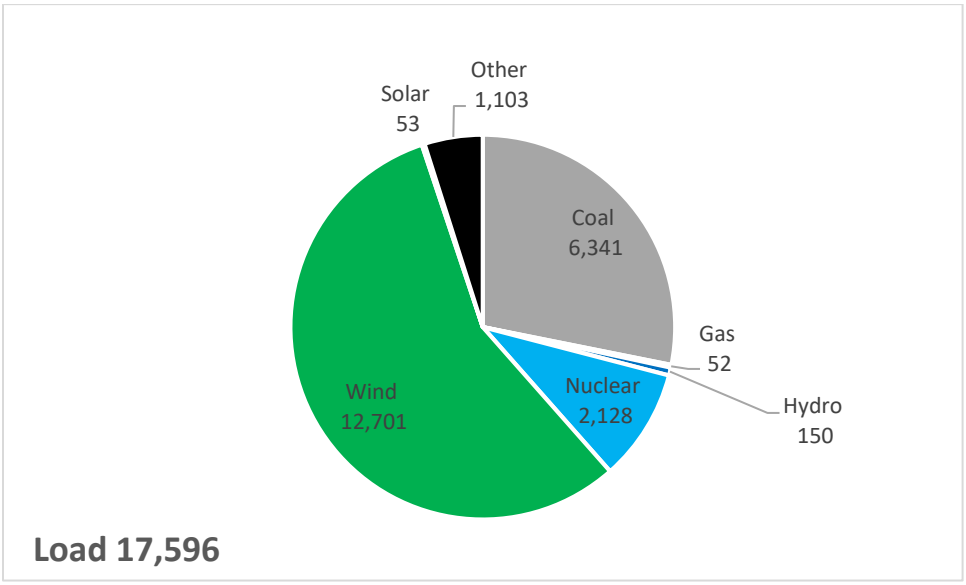




Wind generation is high and load is a moderate morning peak. The biggest constraints are:
(A) Cleveland to Le Center 69 kV in the event of an outage of Wilmarth to Sheas Lake 345 kV
(B) Hibbard to Winter Street 115 kV in the event of an outage of Arrowhead to Gary 115 kV (managed by the Stinson phase shifting transformer, which the analytical tool is unable to model)
(K) Spring Creek 161/69 kV transformer in the event of an outage of Spring Creek parallel transformer
CROW Outages significantly impacting congestion:
[3] Nelson to Gil Tap 69 kV

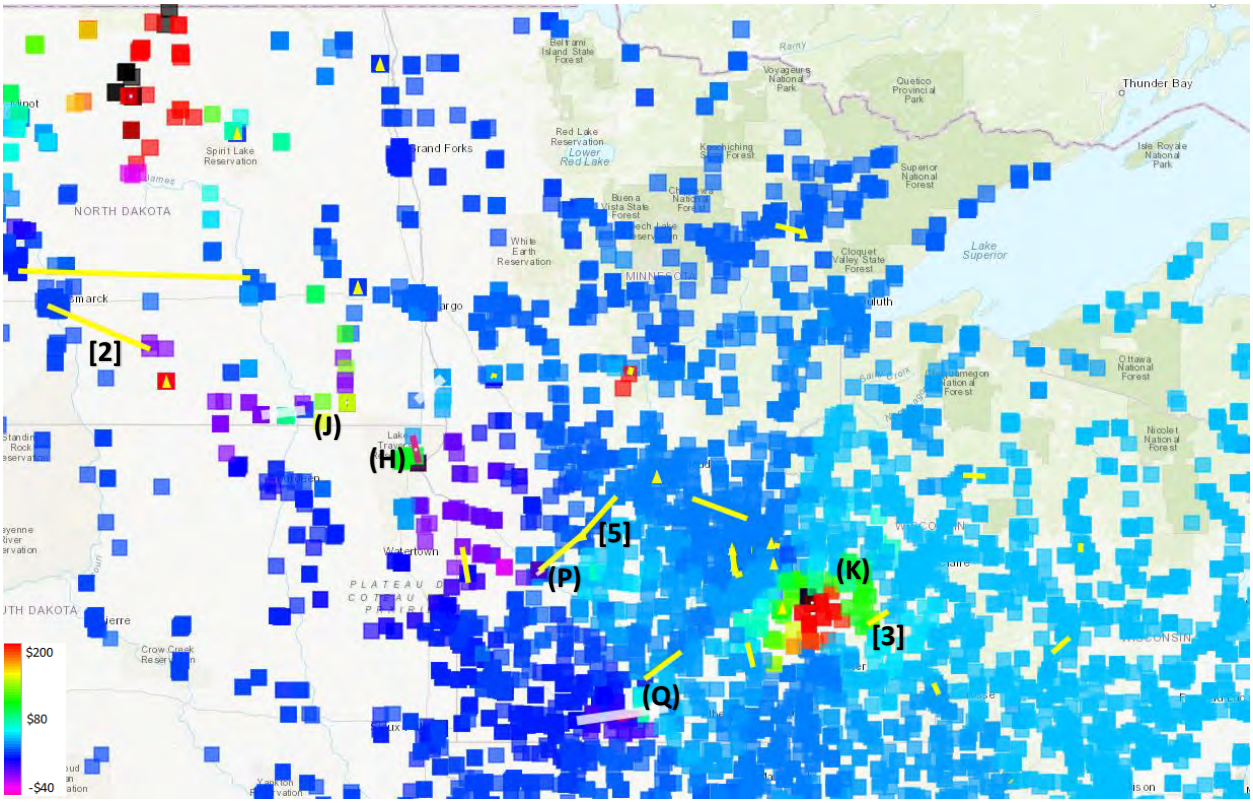
Week of 10/3/2022 Most congested hour 10/6/2022 7:00

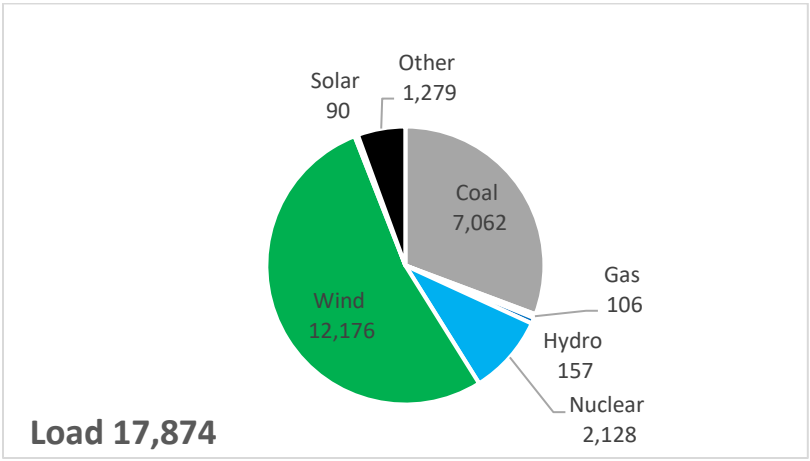




Wind generation is high and load is a moderate morning peak. The biggest constraints are:
(A) Cleveland to Le Center 69 kV in the event of an outage of Wilmarth to Sheas Lake 345 kV
(K) Spring Creek 161/69 kV transformer in the event of an outage of Spring Creek parallel transformer
CROW Outages significantly impacting congestion:
[3] Nelson to Gil Tap 69 kV
[4] Prairie Island to North Rochester 345 kV

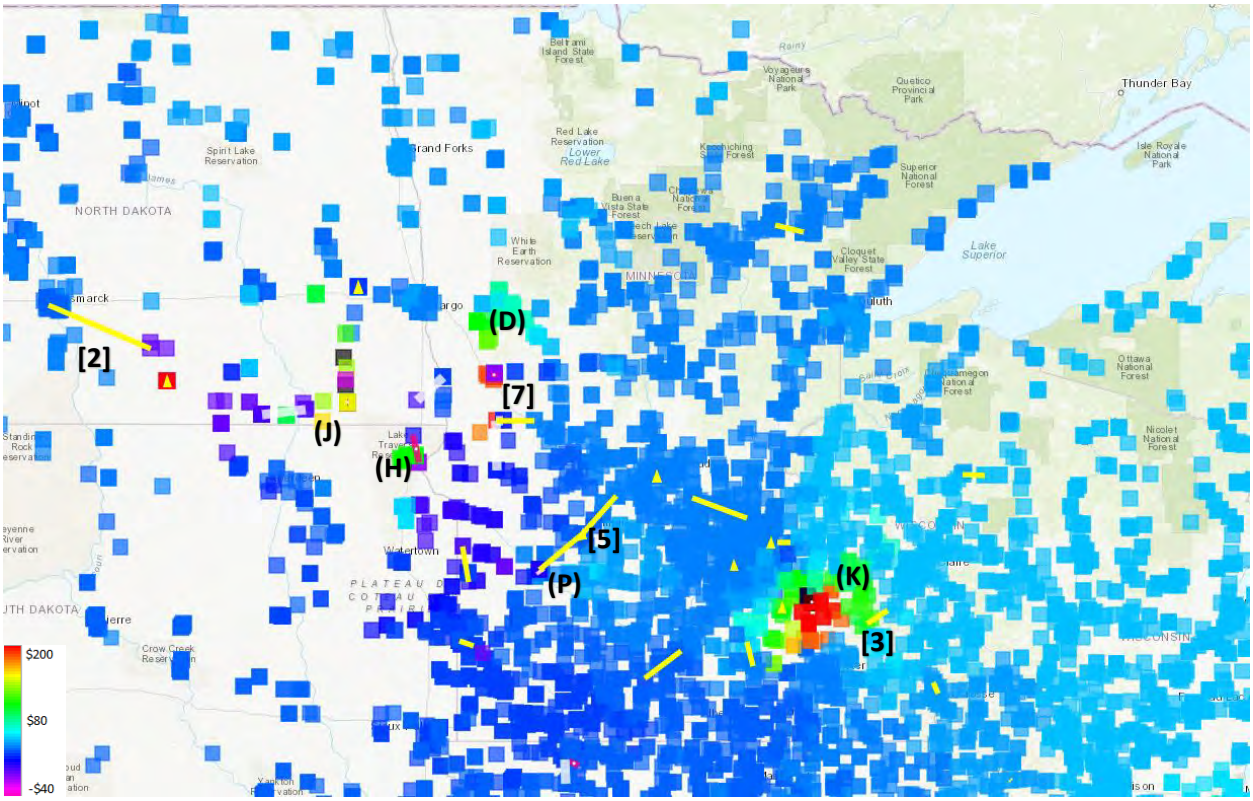
Week of 10/10/2022 Most congested hour 10/12/2022 19:00

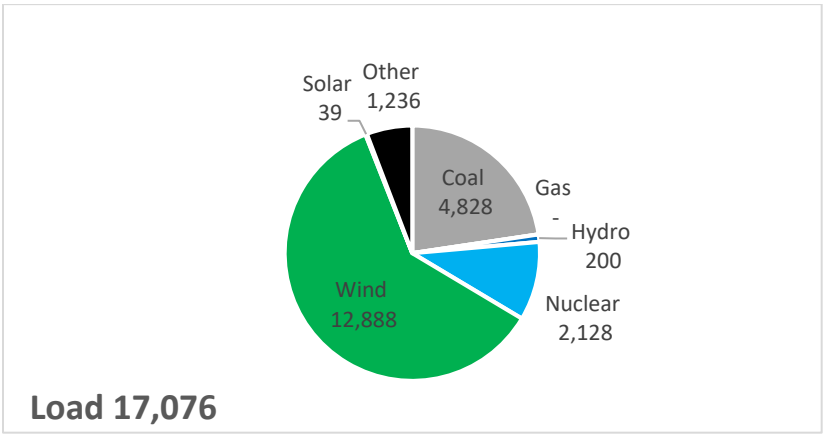




Wind generation is high and load is a moderate evening peak. The biggest constraints are:
(H) Browns Valley to New Effington 230 kV in the event of an outage of Oakes to Ellendale 230 kV
(J) Forman 345/115 kV transformer in the event of an outage of Hankinson to Wahpeton 230 kV
(K) Spring Creek 161/69 kV transformer in the event of an outage of Spring Creek parallel transformer
(P) Minn Valley to Granite Falls 230 kV in the event of an outage of Minn Valley Tap to Granite Falls 230
(Q) Rutland to Fox Lake 161 kV in the event of an outage of Lakefield to Huntley 345 kV
CROW Outages significantly impacting congestion:
[2] Mandan to Napoleon 230 kV
[3] Nelson to Gil Tap 69 kV
[5] Granite Falls to Willmar to Paynesville 230 kV

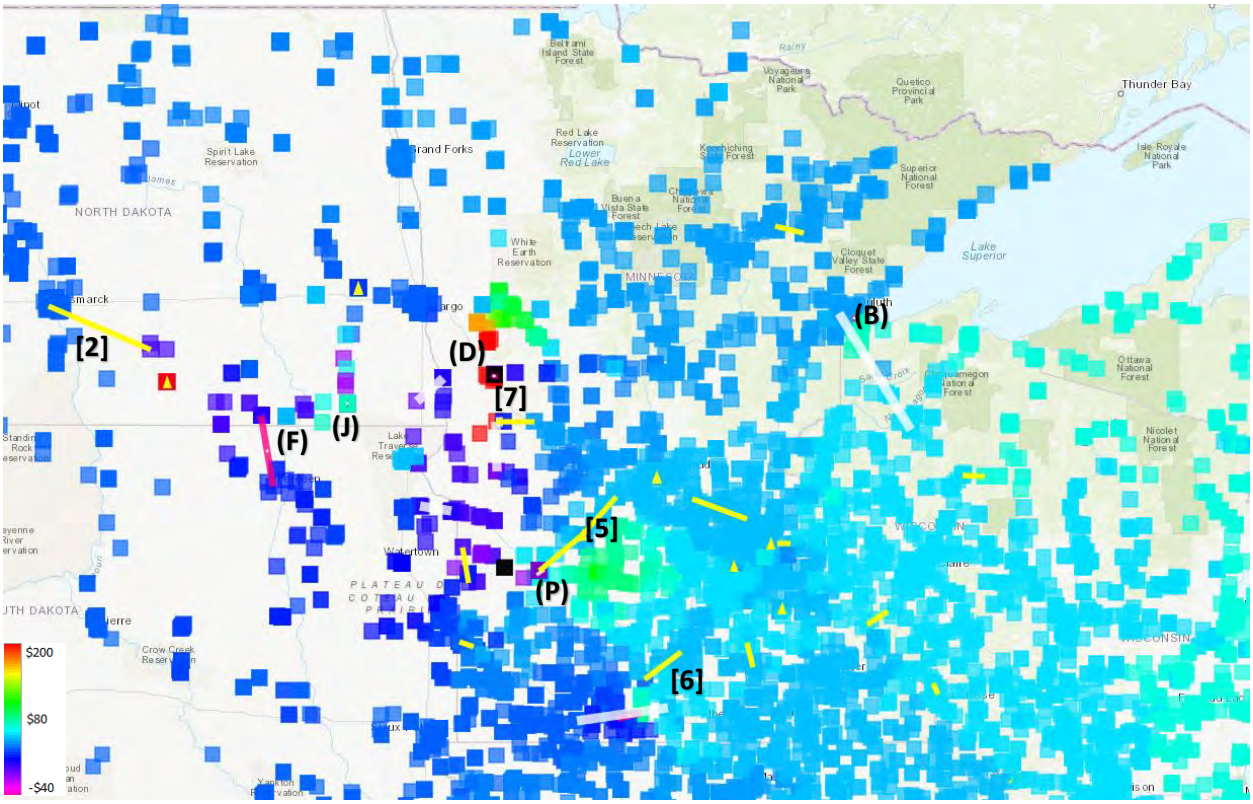
Week of 10/17/2022 Most congested hour 10/21/2022 20:00

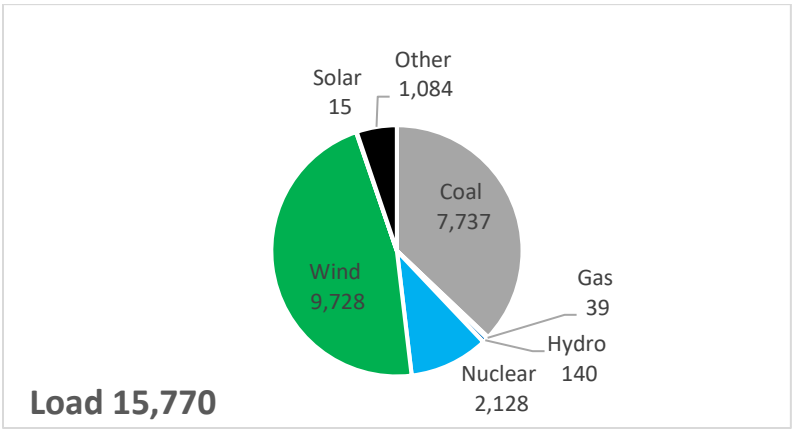




Wind generation is high and load is a moderate evening peak. The biggest constraints are:
(D) Hoot Lake to Fergus Falls 115 kV in the event of an outage of Grant County to Elbow Lake 115 kV
(H) Browns Valley to New Effington 230 kV in the event of an outage of Oakes to Ellendale 230 kV
(J) Forman 345/115 kV transformer in the event of an outage of Hankinson to Wahpeton 230 kV
(K) Spring Creek 161/69 kV transformer in the event of an outage of Spring Creek parallel transformer
(P) Minn Valley to Granite Falls 230 kV in the event of an outage of Minn Valley Tap to Granite Falls 230
CROW Outages significantly impacting congestion:
[2] Mandan to Napoleon 230 kV
[3] Nelson to Gil Tap 69 kV
[5] Granite Falls to Willmar to Paynesville 230 kV
[7] Elbow Lake to Brandon 115 kV

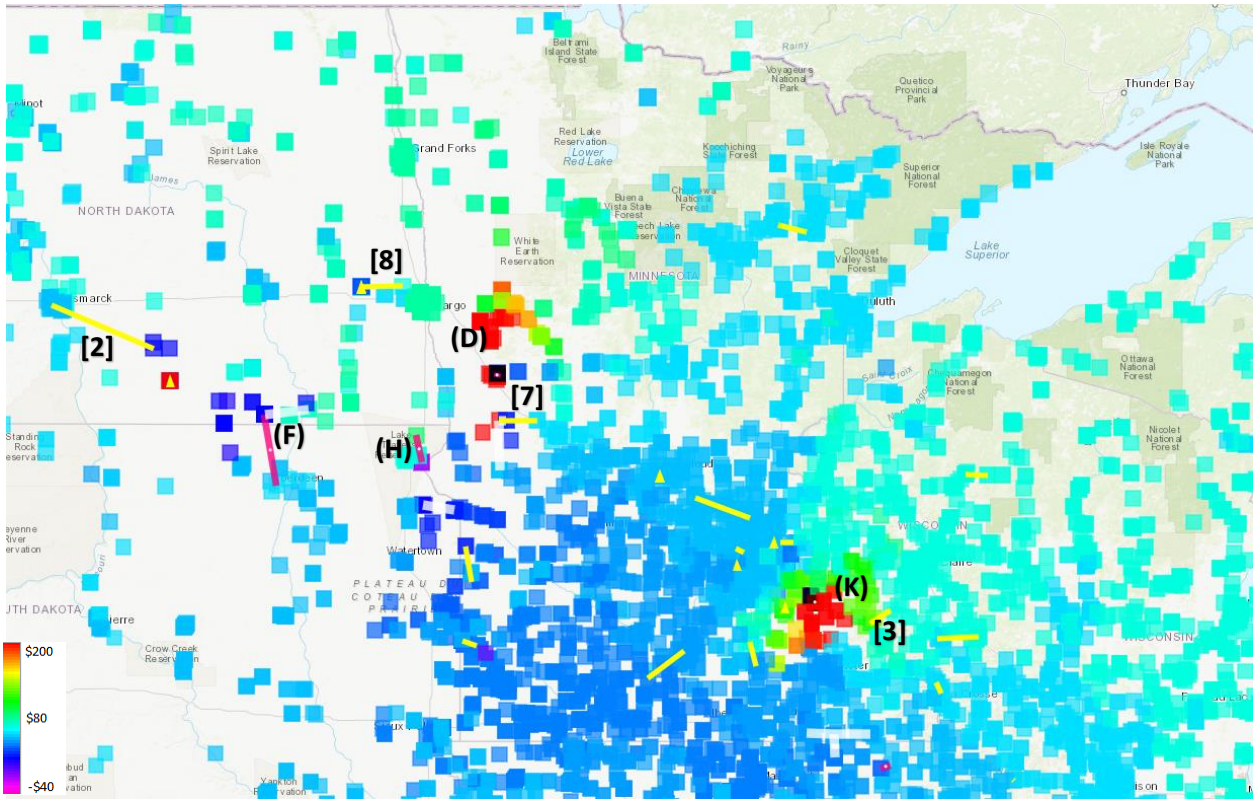
Week of 10/24/2022 Most congested hour 10/24/2022 5:00

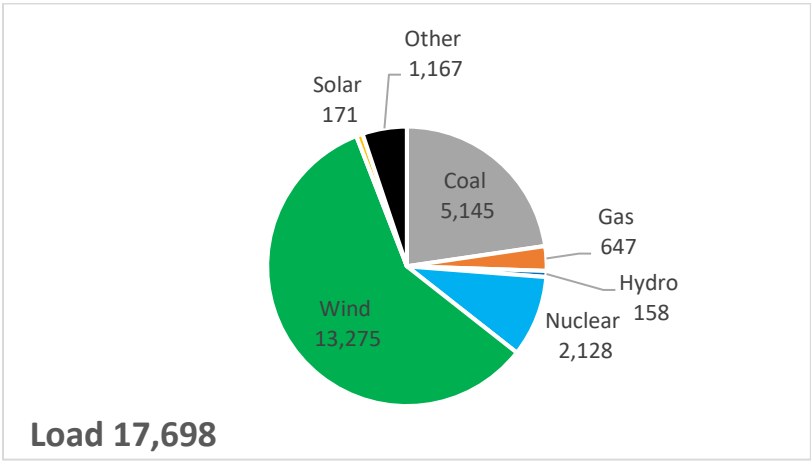




Wind generation is moderate and load is a light morning load. The biggest constraints are:
(B) Hibbard to Winter Street 115 kV in the event of an outage of Arrowhead to Gary 115 kV (managed by the Stinson phase shifting transformer, which the analytical tool is unable to model)
(D) Hoot Lake to Fergus Falls 115 kV in the event of an outage of Fergus Falls to Silver Lake 230 kV
(F) Ellendale to Aberdeen Jct 115 kV in the event of an outage of Twin Brooks-Big Stone South 345 kV
(J) Forman 345/115 kV transformer in the event of an outage of Hankinson to Wahpeton 230 kV
(P) Minn Valley to Granite Falls 230 kV in the event of an outage of Minn Valley Tap to Granite Falls 230
CROW Outages significantly impacting congestion:
[2] Mandan to Napoleon 230 kV
[5] Granite Falls to Willmar to Paynesville 230 kV
[6] Crandal to Wilmarth 345 kV
[7] Elbow Lake to Brandon 115 kV

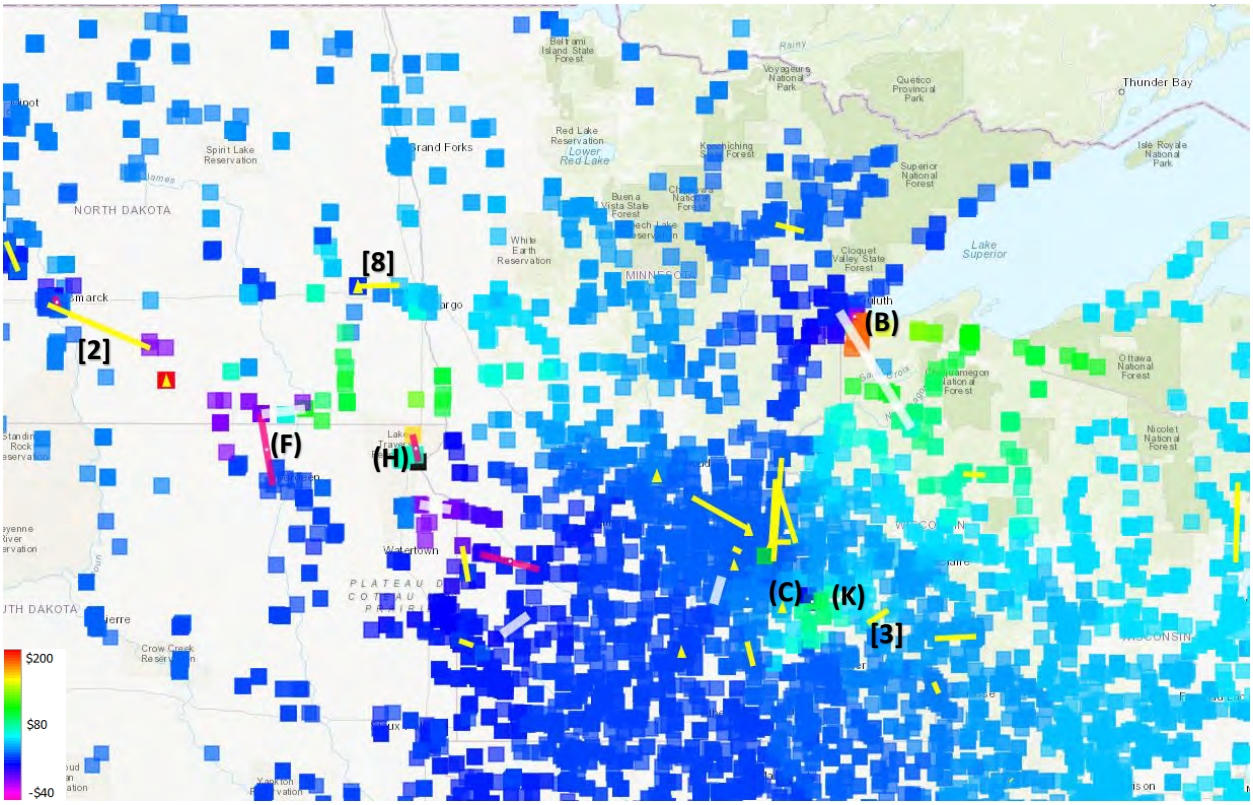
Week of 10/31/2022 Most congested hour 10/31/2022 11:00

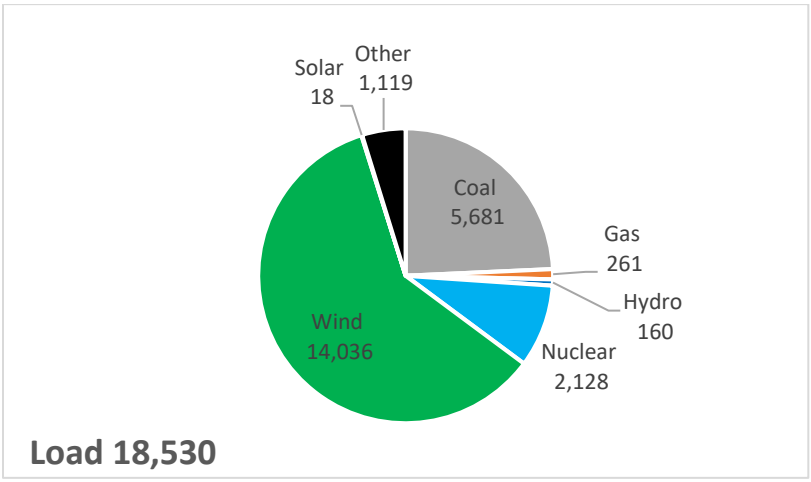




Wind generation is high and load is a moderate mid-day load. The biggest constraints are:
(D) Hoot Lake to Fergus Falls 115 kV in the event of an outage of Fergus Falls to Silver Lake 230 kV
(F) Ellendale to Aberdeen Jct 115 kV in the event of an outage of Twin Brooks-Big Stone South 345 kV
(H) Browns Valley to New Effington 230 kV in the event of an outage of Oakes to Ellendale 230 kV
(K) Spring Creek 161/69 kV transformer in the event of an outage of Spring Creek parallel transformer
CROW Outages significantly impacting congestion:
[2] Mandan to Napoleon 230 kV
[3] Nelson to Gil Tap 69 kV
[7] Elbow Lake to Brandon 115 kV
[8] Buffalo to Bison 345 kV

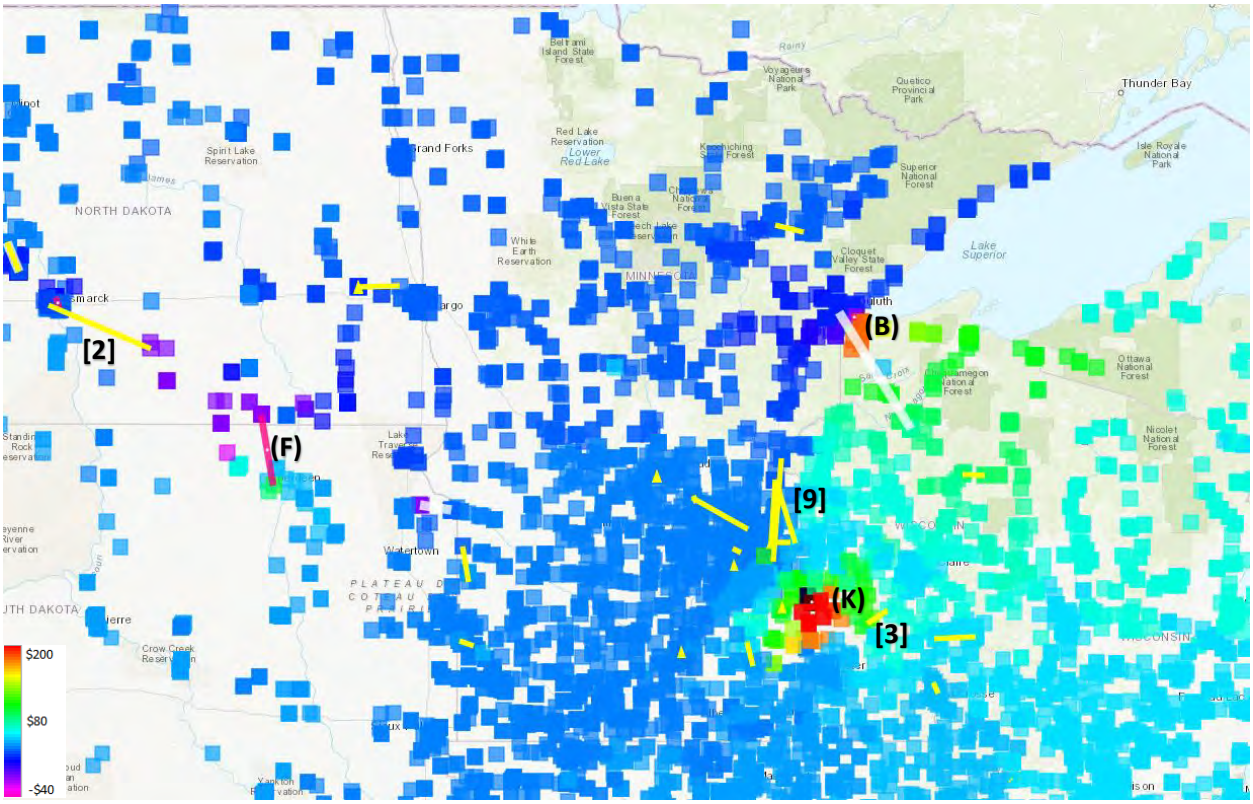
Week of 11/7/2022 Most congested hour 11/9/2022 18:00

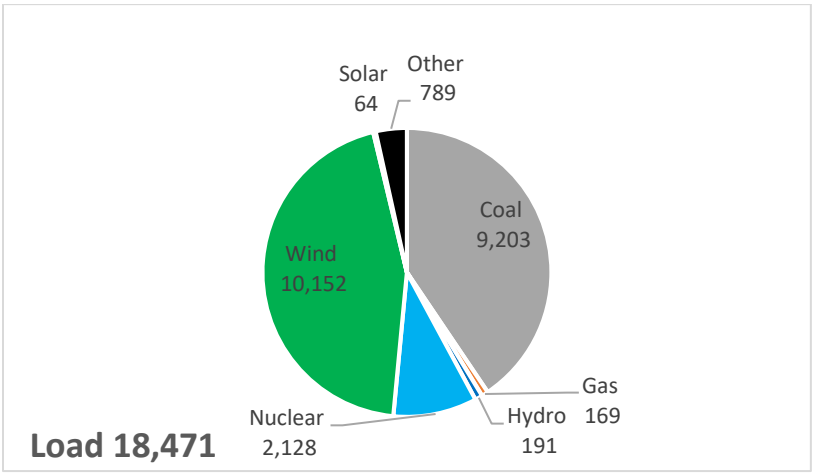




Wind generation is high and load is a moderate evening peak. The biggest constraints are:
(B) Hibbard to Winter Street 115 kV in the event of an outage of Arrowhead to Gary 115 kV (managed by the Stinson phase shifting transformer, which the analytical tool is unable to model)
(C) Chub Lake 345/115 kV transformer in the event of an outage of Helena to Scott County 345 kV (being addressed in MTEP process)
(F) Ellendale to Aberdeen Jct 115 kV in the event of an outage of Twin Brooks-Big Stone South 345 kV
(H) Browns Valley to New Effington 230 kV in the event of an outage of Oakes to Ellendale 230 kV
(K) Spring Creek 161/69 kV transformer in the event of an outage of Spring Creek parallel transformer
CROW Outages significantly impacting congestion:
[2] Mandan to Napoleon 230 kV
[3] Nelson to Gil Tap 69 kV[8] Buffalo to Bison 345 kV

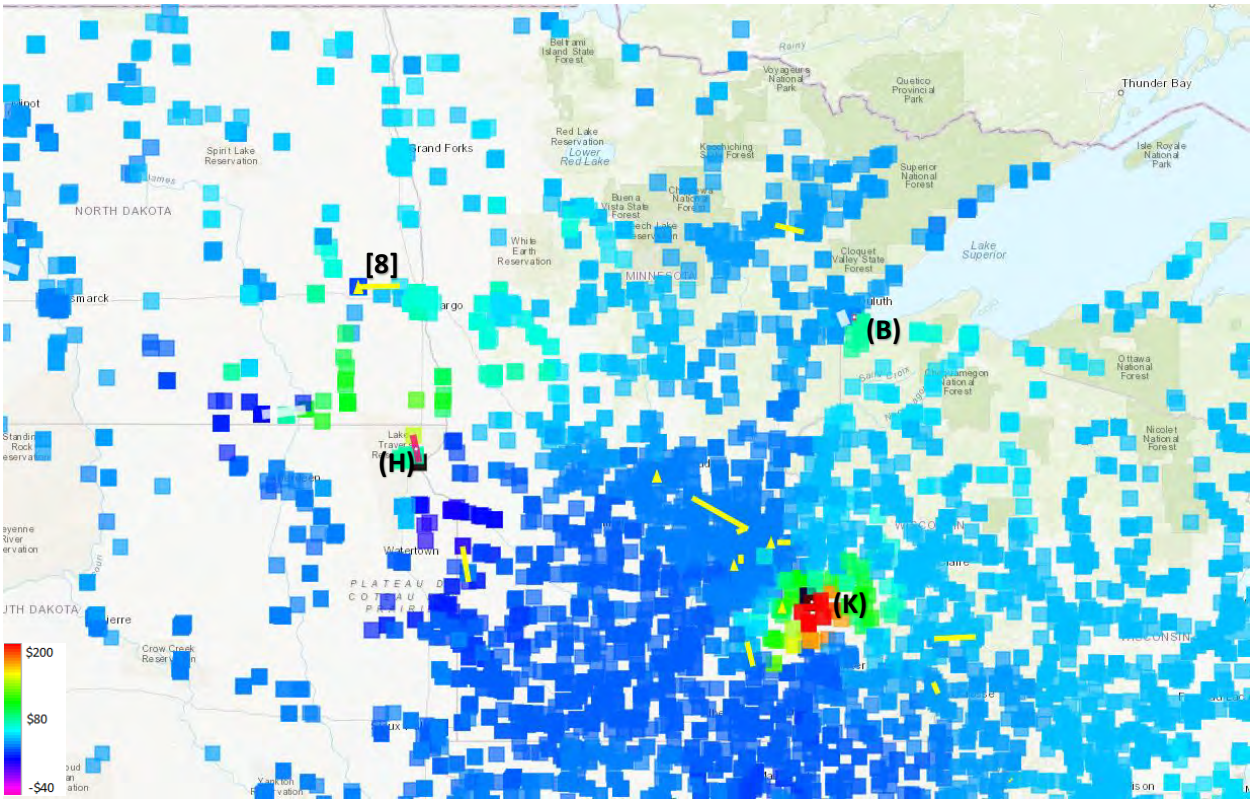
Week of 11/14/2022 Most congested hour 11/14/2022 8:00

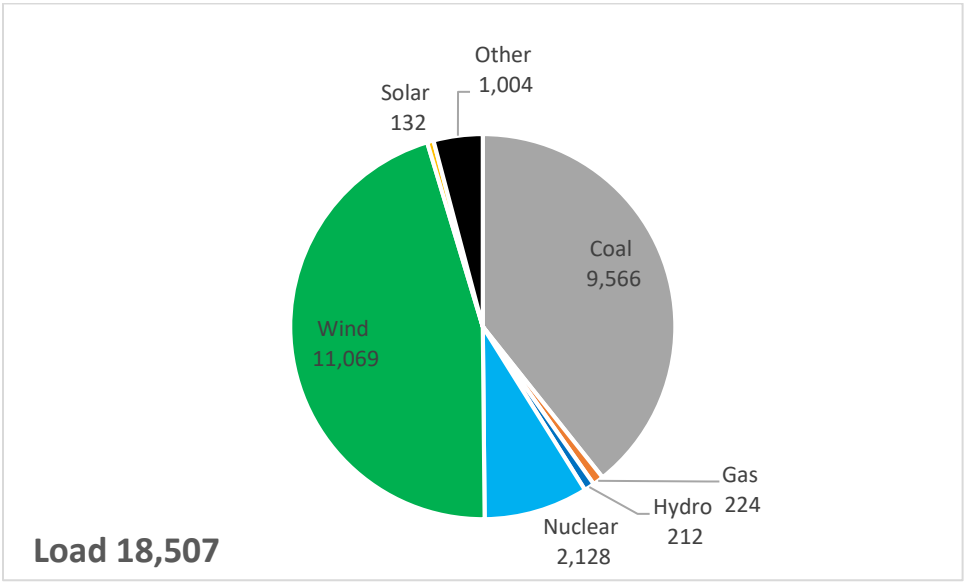




Wind generation is high and load is a moderate morning peak. The biggest constraints are:
(B) Hibbard to Winter Street 115 kV in the event of an outage of Arrowhead to Gary 115 kV (managed by the Stinson phase shifting transformer, which the analytical tool is unable to model)
(F) Ellendale to Aberdeen Jct 115 kV in the event of an outage of Twin Brooks-Big Stone South 345 kV
(K) Spring Creek 161/69 kV transformer in the event of an outage of Spring Creek parallel transformer
CROW Outages significantly impacting congestion:
[2] Mandan to Napoleon 230 kV
[3] Nelson to Gil Tap 69 kV
[9] Chisago County to King 345 kV and Chisago County to Kohlman Lake 345 kV

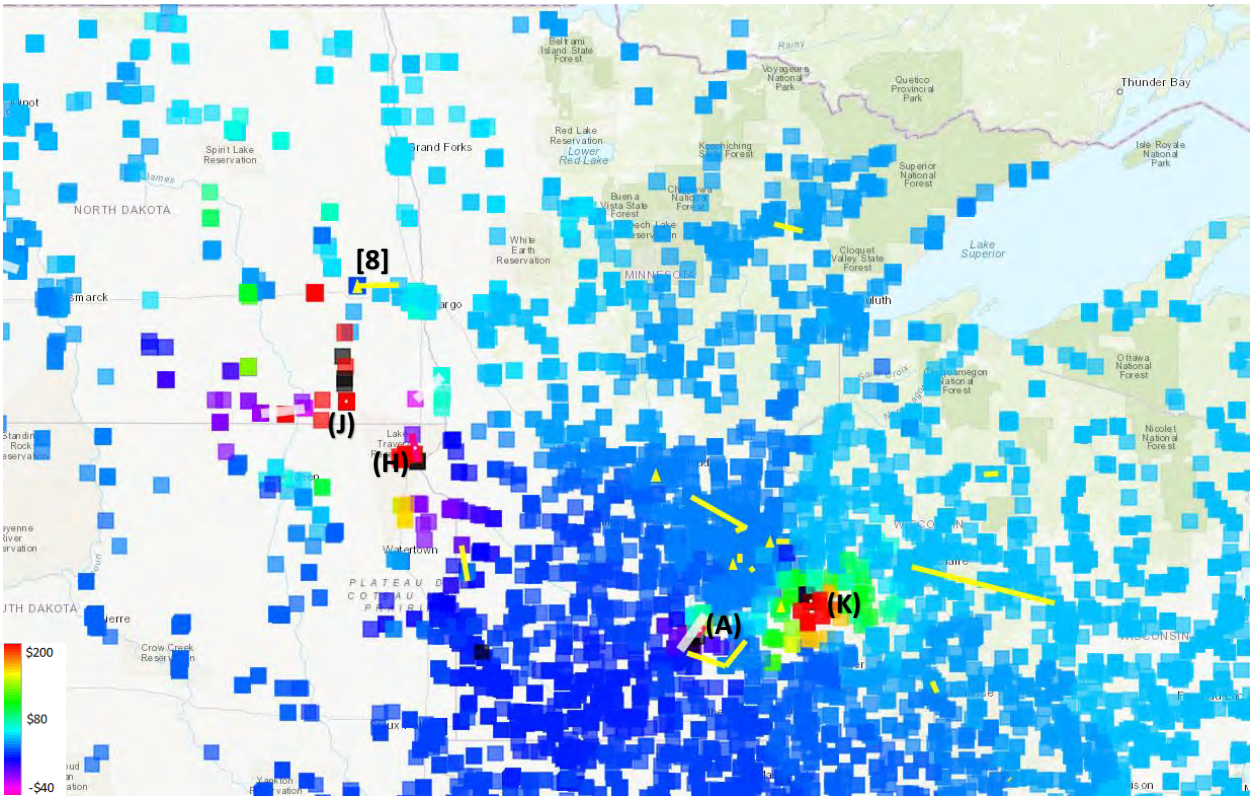
Week of 11/21/2022 Most congested hour 11/23/2022 15:00

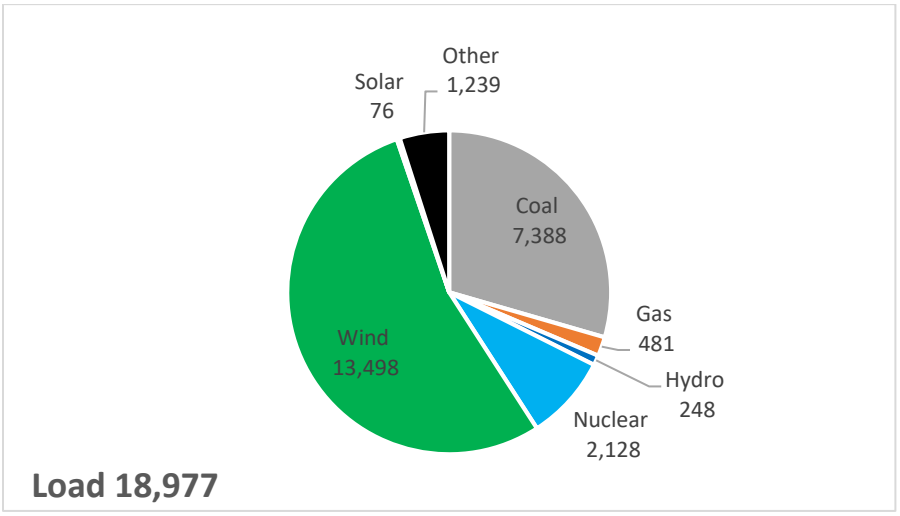




Wind generation is high and load is a moderate afternoon load. The biggest constraints are:
(B) Hibbard to Winter Street 115 kV in the event of an outage of Arrowhead to Gary 115 kV (managed by the Stinson phase shifting transformer, which the analytical tool is unable to model)
(H) Browns Valley to New Effington 230 kV in the event of an outage of Oakes to Ellendale 230 kV
(K) Spring Creek 161/69 kV transformer in the event of an outage of Spring Creek parallel transformer
CROW Outages significantly impacting congestion:
[8] Buffalo to Bison 345 kV

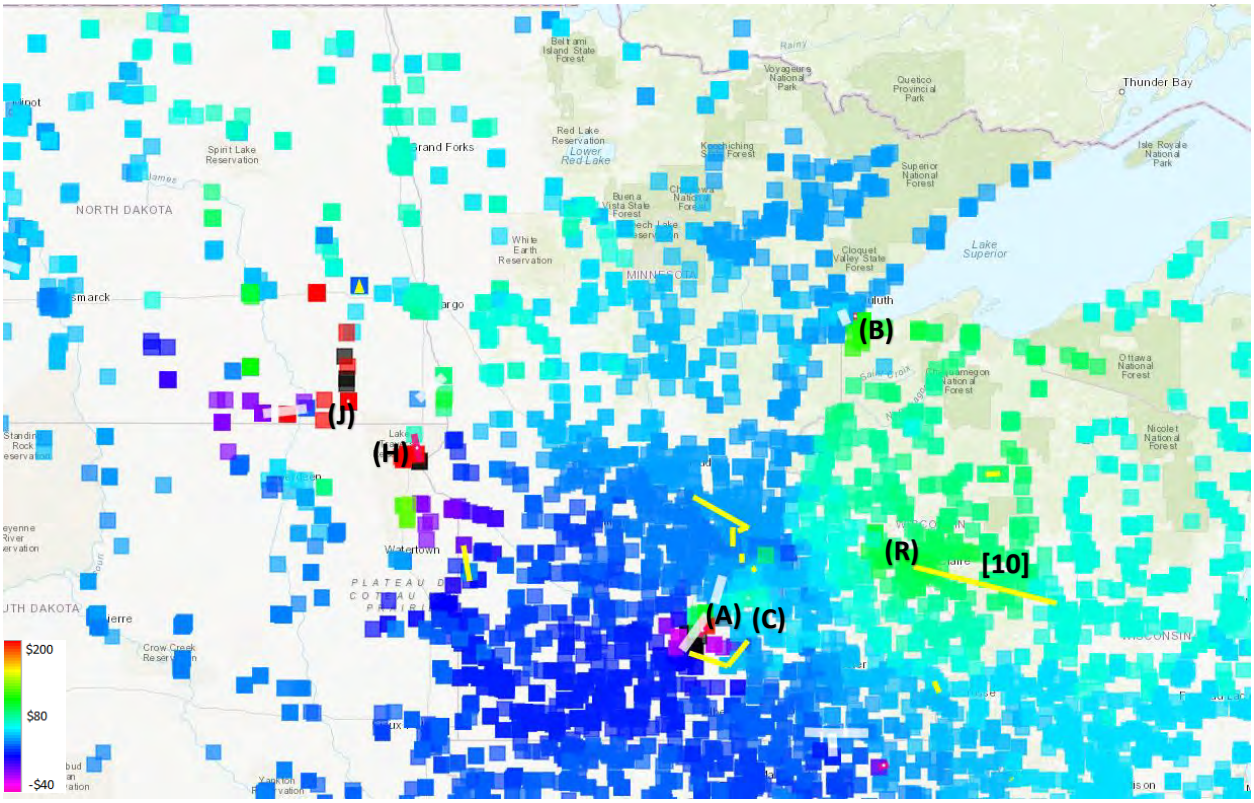
Week of 11/28/2022 Most congested hour 11/28/2022 18:00

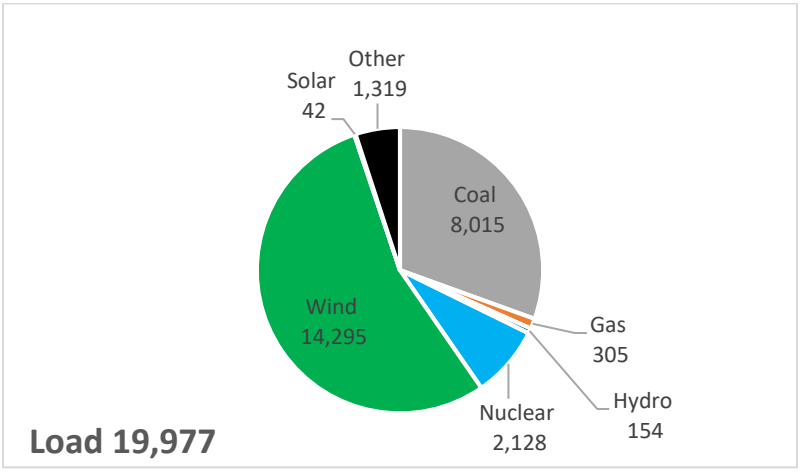




Wind generation is high and load is a moderate evening peak. The biggest constraints are:
(A) Cleveland to Le Center 69 kV in the event of an outage of Wilmarth to Sheas Lake 345 kV
(H) Browns Valley to New Effington 230 kV in the event of an outage of Oakes to Ellendale 230 kV
(J) Forman 345/115 kV transformer in the event of an outage of Hankinson to Wahpeton 230 kV
(K) Spring Creek 161/69 kV transformer in the event of an outage of Spring Creek parallel transformer
CROW Outages significantly impacting congestion:
[8] Buffalo to Bison 345 kV

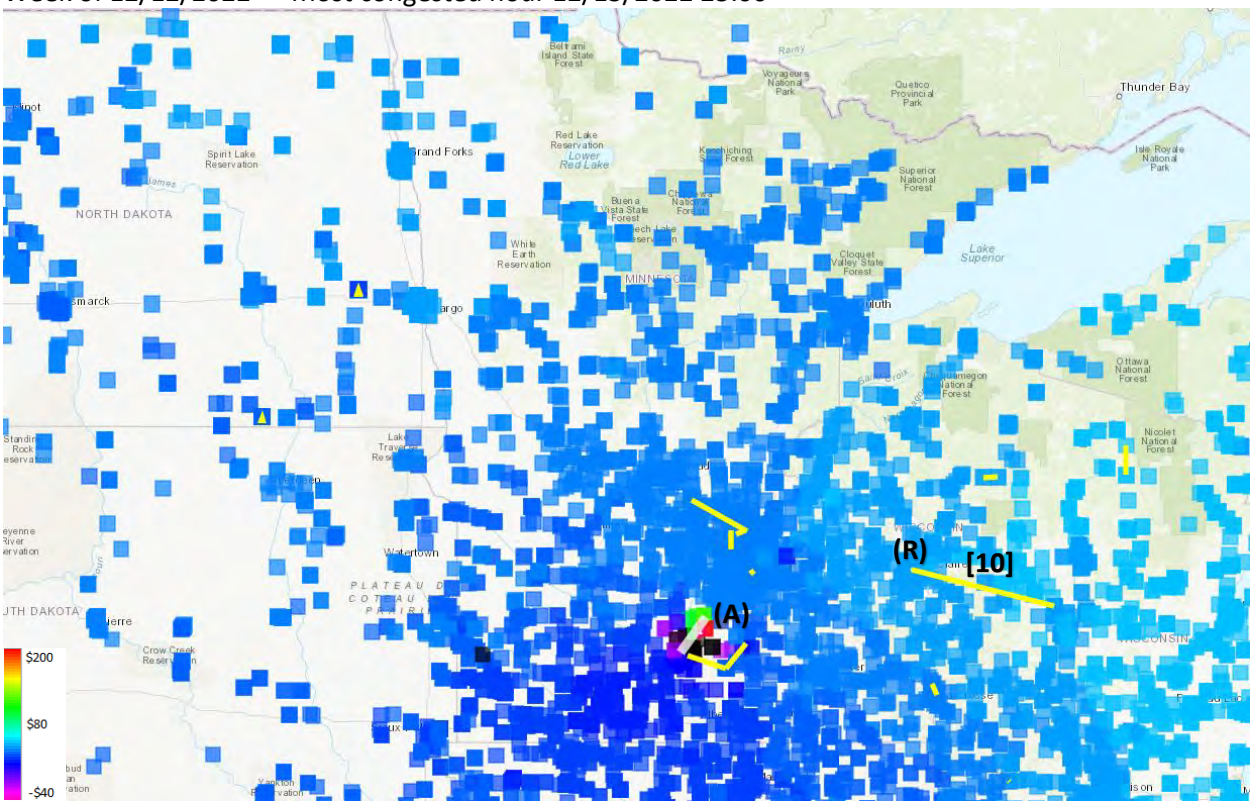
Week of 12/5/2022 Most congested hour 12/5/2022 8:00

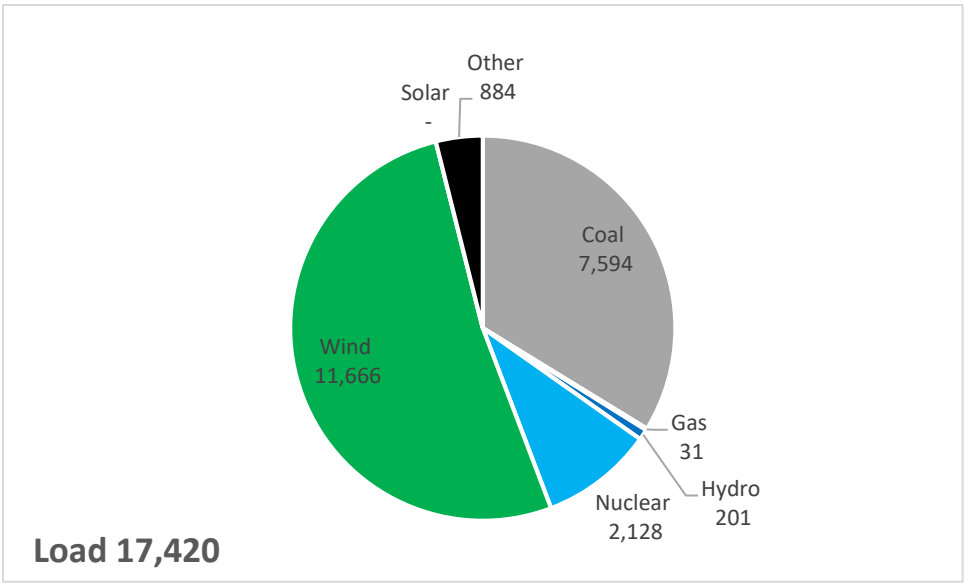




Wind generation is high and load is a high morning peak. The biggest constraints are:
(A) Cleveland to Le Center 69 kV in the event of an outage of Wilmarth to Sheas Lake 345 kV
(B) Hibbard to Winter Street 115 kV in the event of an outage of Arrowhead to Gary 115 kV (managed by the Stinson phase shifting transformer, which the analytical tool is unable to model)
(C) Chub Lake 345/115 kV transformer in the event of an outage of Helena to Scott County 345 kV (being addressed in MTEP process)
(H) Browns Valley to New Effington 230 kV in the event of an outage of Oakes to Ellendale 230 kV
(J) Forman 345/115 kV transformer in the event of an outage of Hankinson to Wahpeton 230 kV
(R) Eau Claire 345/161 kV transformer in the event of an outage of Eau Claire parallel transformer
CROW Outages significantly impacting congestion:
[10] Eau Claire to Arpin 345 kV

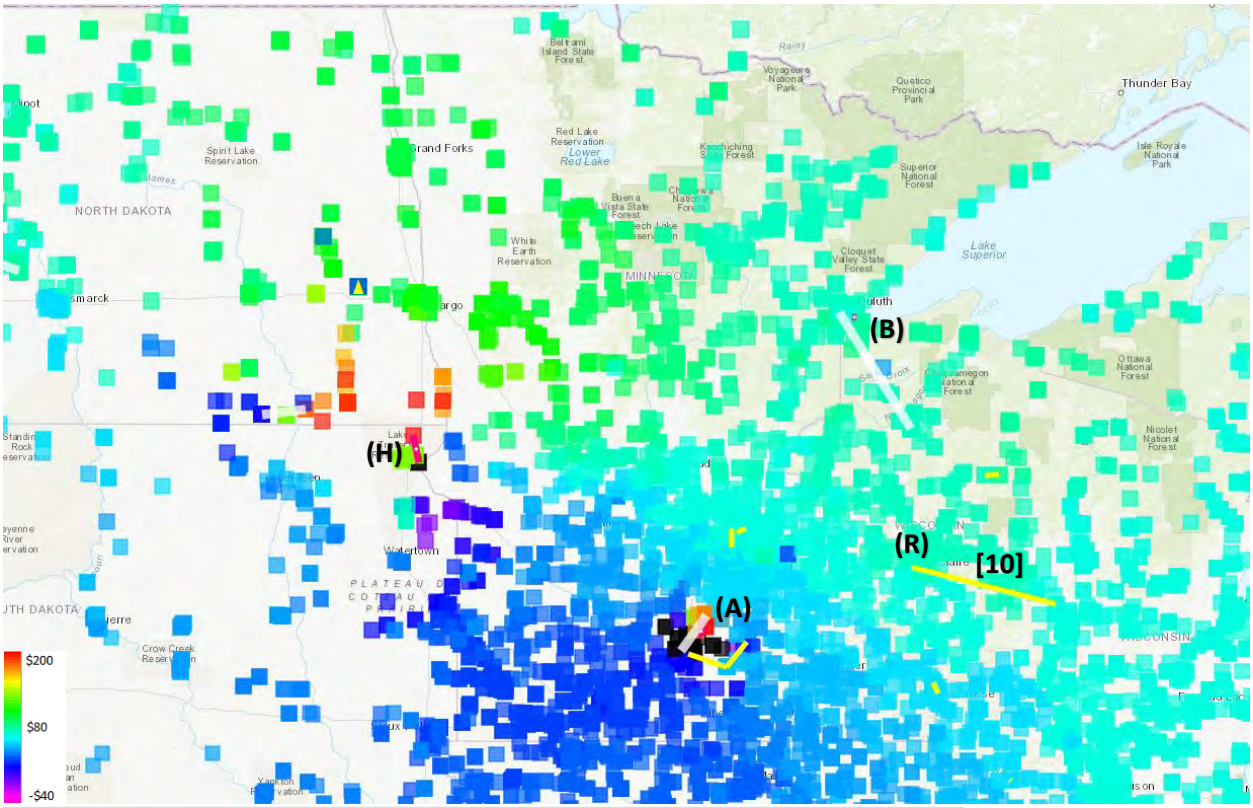
Week of 12/12/2022 Most congested hour 12/13/2022 23:00

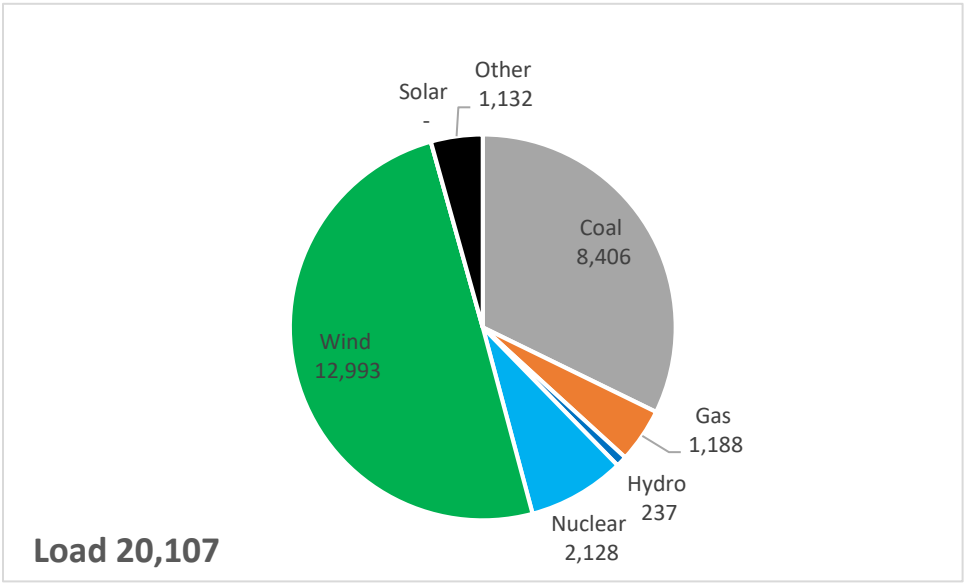




Wind generation is high and load is a moderate night load. The biggest constraints are:
(A) Cleveland to Le Center 69 kV in the event of an outage of Wilmarth to Sheas Lake 345 kV
(R) Eau Claire 345/161 kV transformer in the event of an outage of Eau Claire parallel transformer
CROW Outages significantly impacting congestion:
[10] Eau Claire to Arpin 345 kV

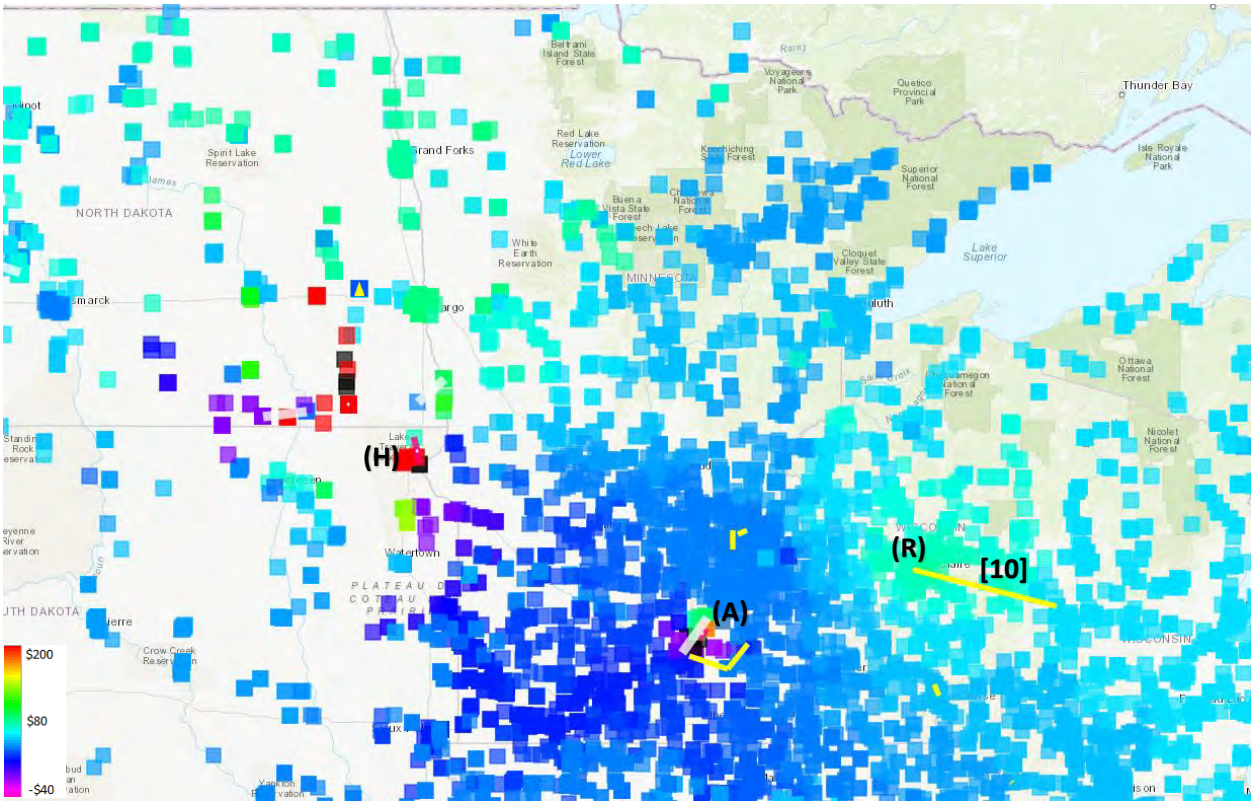
Week of 12/19/2022 Most congested hour 12/23/2022 18:00

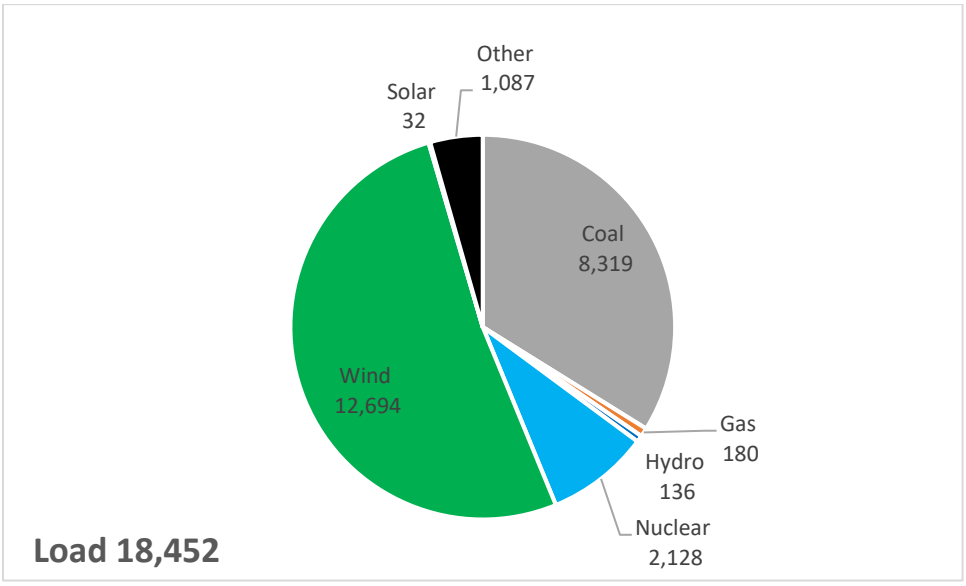




Wind generation is high and load is a high evening peak. The biggest constraints are:
(A) Cleveland to Le Center 69 kV in the event of an outage of Wilmarth to Sheas Lake 345 kV
(B) Hibbard to Winter Street 115 kV in the event of an outage of Arrowhead to Stone Lake 345 kV
(managed by the Stinson phase shifting transformer, which the analytical tool is unable to model)
(H) Browns Valley to New Effington 230 kV in the event of an outage of Oakes to Ellendale 230 kV
(R) Eau Claire 345/161 kV transformer in the event of an outage of Eau Claire parallel transformer
CROW Outages significantly impacting congestion:
[10] Eau Claire to Arpin 345 kV

Week of 12/26/2022 Most congested hour 12/26/2022 9:00





Wind generation is high and load is a moderate morning peak. The biggest constraints are:
(A) Cleveland to Le Center 69 kV in the event of an outage of Wilmarth to Sheas Lake 345 kV
(H) Browns Valley to New Effington 230 kV in the event of an outage of Oakes to Ellendale 230 kV
(R) Eau Claire 345/161 kV transformer in the event of an outage of Eau Claire parallel transformer
CROW Outages significantly impacting congestion:
[10] Eau Claire to Arpin 345 kV

Planned Outage + Forced Outage Operating State

Future forced outages events are unknown. Engineering judgement was used to select a plausible high impact forced outage scenario including the outage of these lines in the forced outage operating state:

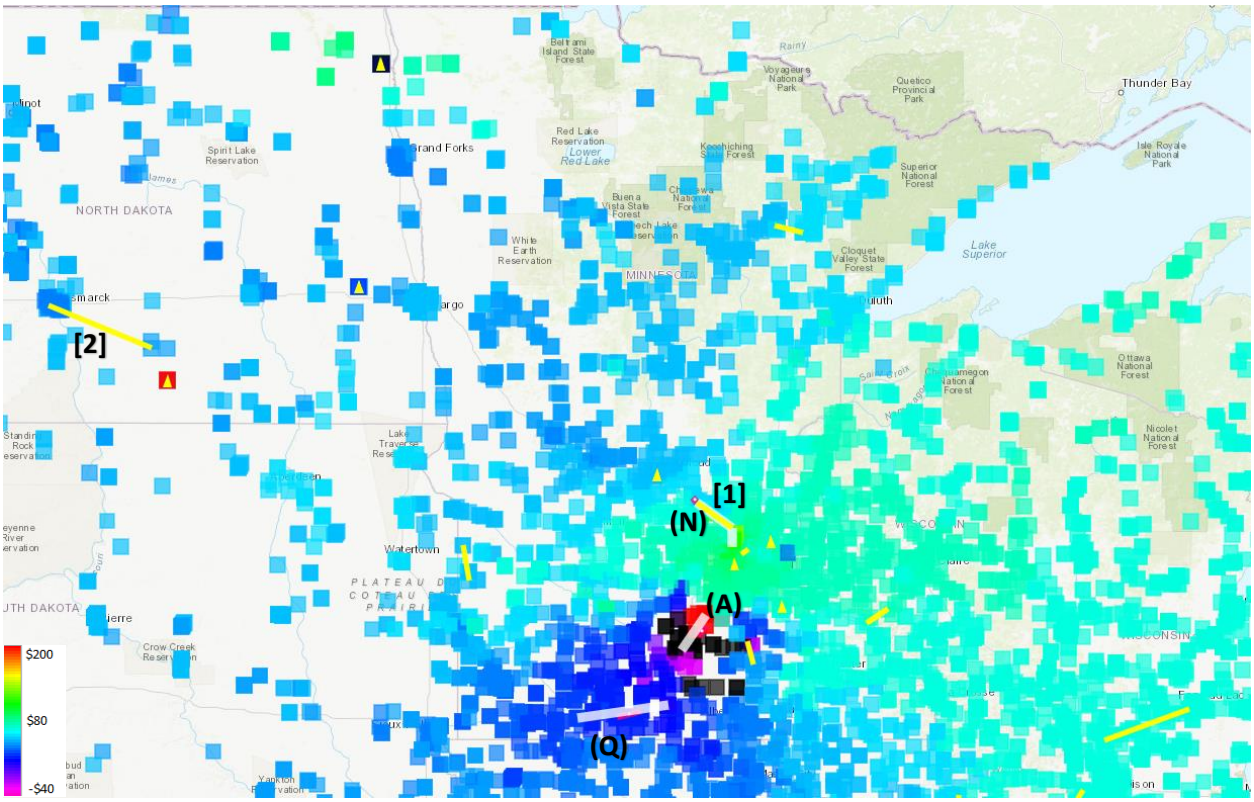
- Wilmarth to Crandal 345 kV
- Hankinson to Wahpeton 230 kV
- King to Eau Claire 345 kV

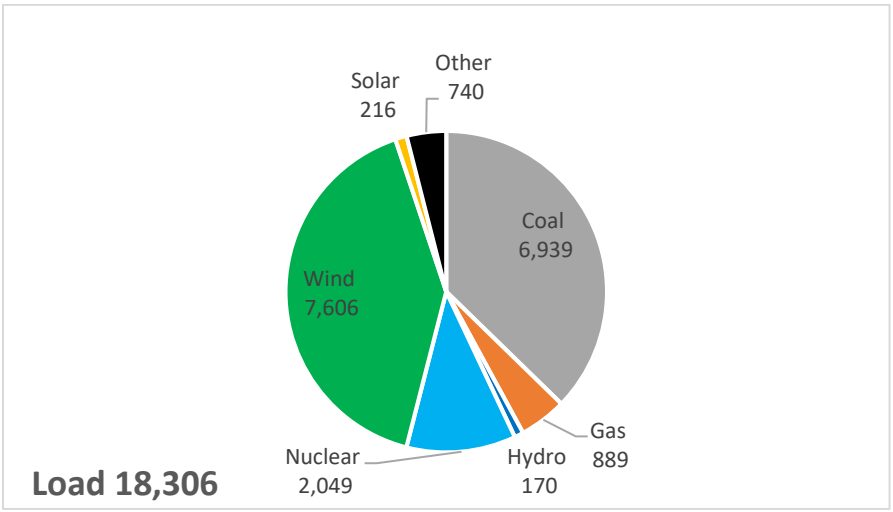
Weekly summary table of congestion and generation fuel mix in the study footprint for planned outage plus forced outage operating state.

Week Of	Hours Congested	Shadow Sum	Top 3 constraints for the week	Coal	Gas	Hydro	Nuclear	Wind	Solar	Other	Load	Worst Hour
8/29/2022	160	$62,078	[$17,408] GRE-CLVLAND8 to LECENTR8 #1 [$11,895] FORMN 7 to FORMAN 7 #1 [$10,919] GRE-SPRGCK15 to YBUS(GRE-SPRNGCK8,GRE-SPRNGC1T) #1	1,056,784	127,197	31,550	344,180	1,185,553	17,617	125,714	2,825,102	8/29/2022 12:00
9/5/2022	168	$33,713	[$19,232] FORMN 7 to FORMAN 7 #1 [$4,432] GRE-SPRGCK15 to YBUS(GRE-SPRNGCK8,GRE-SPRNGC1T) #1 [$3,112] MNTCELO3 to SHERCO 3 #1	1,241,430	314,288	30,725	344,180	957,906	16,191	102,966	3,117,422	9/5/2022 8:00
9/12/2022	168	$96,841	[$22,499] GRE-SPRGCK15 to YBUS(GRE-SPRNGCK8,GRE-SPRNGC1T) #1 [$17,752] GRE-JOHNJCT7 to MORRIS 7 #1 [$17,750] HIBBARD7 to WNTR ST7 #1	1,052,392	163,263	30,746	344,180	1,235,043	24,367	149,400	2,788,925	9/16/2022 8:00
9/19/2022	168	$80,336	[$23,113] GRE-SPRGCK15 to YBUS(GRE-SPRNGCK8,GRE-SPRNGC1T) #1 [$21,801] FORMN 7 to FORMAN 7 #1 [$10,039] RUTLAND5 to FOX LK 5 #1	1,136,246	109,648	29,932	344,180	1,165,902	18,844	132,169	2,660,315	9/24/2022 7:00
9/26/2022	153	$59,053	[$11,872] HIBBARD7 to WNTR ST7 #1 [$9,953] GRE-SPRGCK15 to YBUS(GRE-SPRNGCK8,GRE-SPRNGC1T) #1 [$9,739] FORMN 7 to FORMAN 7 #1	1,269,836	57,316	31,616	357,462	1,130,018	16,309	130,197	2,706,386	9/26/2022 18:00
10/3/2022	150	$63,838	[$46,163] GRE-SPRGCK15 to YBUS(GRE-SPRNGCK8,GRE-SPRNGC1T) #1 [$8,078] FORMN 7 to FORMAN 7 #1 [$3,288] GRE-CLVLAND8 to LECENTR8 #1	1,469,671	59,599	34,496	357,462	922,215	11,932	109,670	2,730,248	10/6/2022 8:00
10/10/2022	154	$74,350	[$39,753] GRE-SPRGCK15 to YBUS(GRE-SPRNGCK8,GRE-SPRNGC1T) #1 [$13,623] FORMN 7 to FORMAN 7 #1 [$7,477] MINVALT4 to GRANITF4 #1	1,420,248	41,866	34,057	357,462	1,107,630	11,668	122,768	2,732,530	10/13/2022 10:00
10/17/2022	162	$123,843	[$57,963] GRE-SPRGCK15 to YBUS(GRE-SPRNGCK8,GRE-SPRNGC1T) #1 [$19,250] FORMN 7 to FORMAN 7 #1 [$14,094] ROSEAU 4 to MORANVI4 #1	1,099,828	26,827	33,975	357,462	1,597,738	22,999	153,090	2,732,497	10/18/2022 18:00
10/24/2022	165	$76,179	[$34,683] GRE-SPRGCK15 to YBUS(GRE-SPRNGCK8,GRE-SPRNGC1T) #1 [$16,003] HIBBARD7 to WNTR ST7 #1 [$11,569] FORMN 7 to FORMAN 7 #1	1,561,863	42,614	33,958	357,462	921,183	15,467	116,203	2,754,787	10/24/2022 6:00
10/31/2022	167	$79,622	[$48,722] GRE-SPRGCK15 to YBUS(GRE-SPRNGCK8,GRE-SPRNGC1T) #1 [$11,799] FORMN 7 to FORMAN 7 #1 [$6,526] HIBBARD7 to WNTR ST7 #1	1,536,060	134,736	35,741	357,462	1,006,696	12,749	118,543	2,854,835	11/2/2022 9:00
11/7/2022	167	$109,470	[$66,596] GRE-SPRGCK15 to YBUS(GRE-SPRNGCK8,GRE-SPRNGC1T) #1 [$16,702] HIBBARD7 to WNTR ST7 #1 [$13,531] FORMN 7 to FORMAN 7 #1	1,474,432	89,320	36,982	357,462	1,255,561	12,462	128,318	2,904,752	11/12/2022 13:00
11/14/2022	156	$100,923	[$49,325] GRE-SPRGCK15 to YBUS(GRE-SPRNGCK8,GRE-SPRNGC1T) #1 [$27,286] FORMN 7 to FORMAN 7 #1 [$15,791] HIBBARD7 to WNTR ST7 #1	1,348,137	47,470	36,163	357,462	1,385,139	17,868	139,454	2,751,243	11/17/2022 11:00
11/21/2022	165	$112,452	[$70,182] GRE-SPRGCK15 to YBUS(GRE-SPRNGCK8,GRE-SPRNGC1T) #1 [$14,669] HIBBARD7 to WNTR ST7 #1 [$11,689] FORMN 7 to FORMAN 7 #1	1,450,276	40,006	36,885	357,462	1,487,545	14,946	140,985	2,912,069	11/22/2022 8:00
11/28/2022	165	$97,801	[$40,484] GRE-SPRGCK15 to YBUS(GRE-SPRNGCK8,GRE-SPRNGC1T) #1 [$40,276] FORMN 7 to FORMAN 7 #1 [$3,473] GRE-CLVLAND8 to LECENTR8 #1	1,482,391	175,817	34,705	357,462	1,361,783	12,951	138,332	3,070,232	12/4/2022 21:00
12/5/2022	168	$56,347	[$31,013] GRE-SPRGCK15 to YBUS(GRE-SPRNGCK8,GRE-SPRNGC1T) #1 [$5,981] FORMN 7 to FORMAN 7 #1 [$5,326] HIBBARD7 to WNTR ST7 #1	1,639,698	157,612	32,361	357,462	1,072,920	13,173	116,613	3,029,060	12/5/2022 8:00
12/12/2022	161	$40,509	[$10,526] FORMN 7 to FORMAN 7 #1 [$9,945] HIBBARD7 to WNTR ST7 #1 [$4,521] ABDNJCT7 to ELLENDL7 #1	1,621,257	89,909	32,101	357,462	1,071,986	11,401	110,458	2,988,923	12/18/2022 18:00
12/19/2022	155	$86,708	[$30,975] FORMN 7 to FORMAN 7 #1 [$29,124] GRE-SPRGCK15 to YBUS(GRE-SPRNGCK8,GRE-SPRNGC1T) #1 [$10,168] HIBBARD7 to WNTR ST7 #1	1,478,784	54,281	31,597	357,462	1,512,728	14,538	137,976	2,943,363	12/23/2022 18:00
12/26/2022	168	$122,459	[$66,099] GRE-SPRGCK15 to YBUS(GRE-SPRNGCK8,GRE-SPRNGC1T) #1 [$30,469] FORMN 7 to FORMAN 7 #1 [$10,058] HIBBARD7 to WNTR ST7 #1	1,494,077	216,288	32,777	357,462	1,379,356	12,117	134,289	3,204,048	12/29/2022 22:00

Most congested hour maps

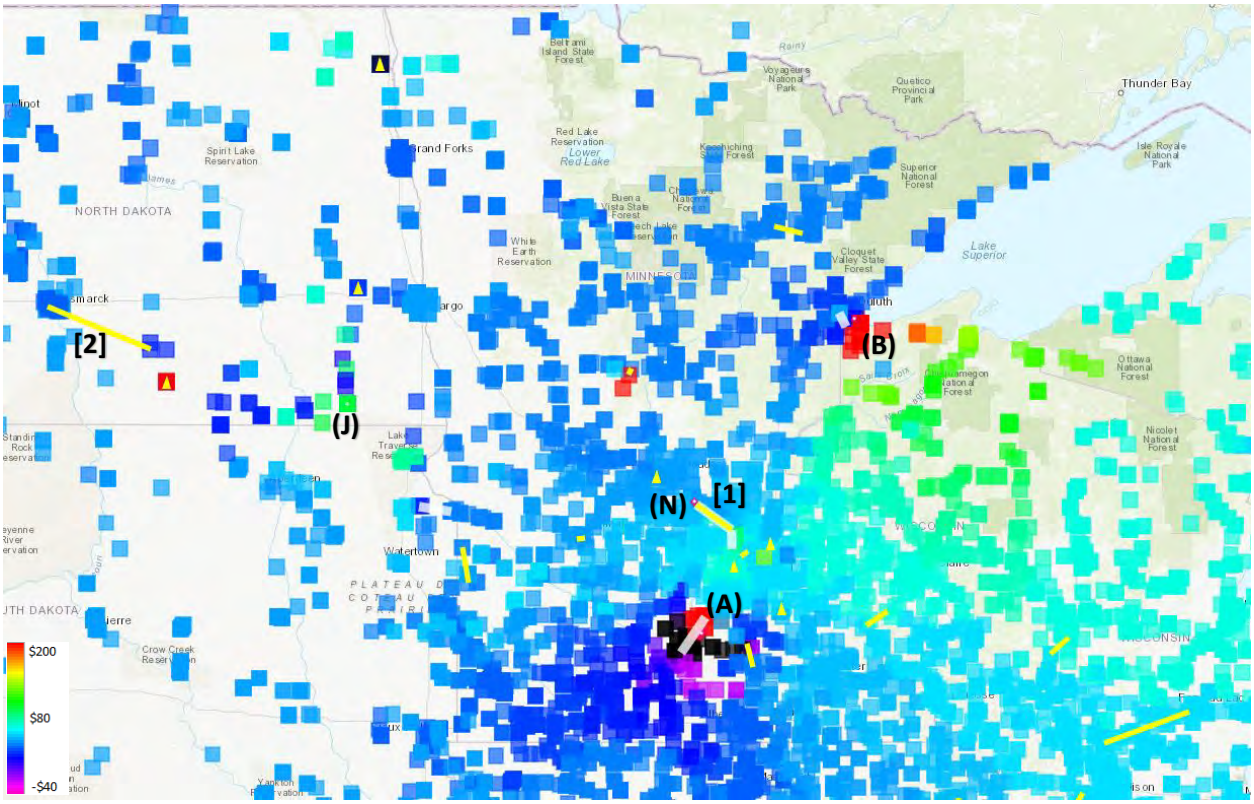
Week of 8/29/2022 Most congested hour 8/29/2022 12:00

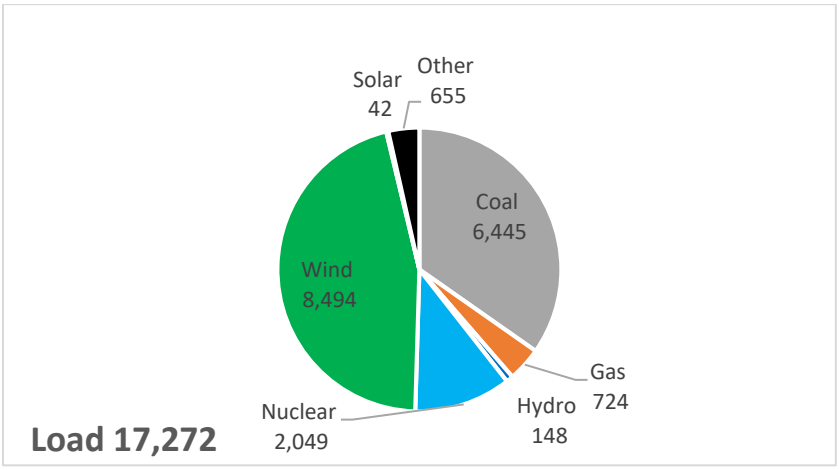




Wind generation is moderate and load is a moderate mid-day load. The biggest constraints are:
(A) Cleveland to Le Center 69 kV in the event of an outage of Wilmarth to Sheas Lake 345 kV
(N) Monticello to Sherco 345 kV in the event of an outage of Elm Creek to Parkers Lake 345 kV
(Q) Rutland to Fox Lake 161 kV in the event of an outage of Lakefield to Huntley 345 kV
CROW Outages significantly impacting congestion:
[1] Elm Creek to Monticello 345 kV
[2] Mandan to Napoleon 230 kV

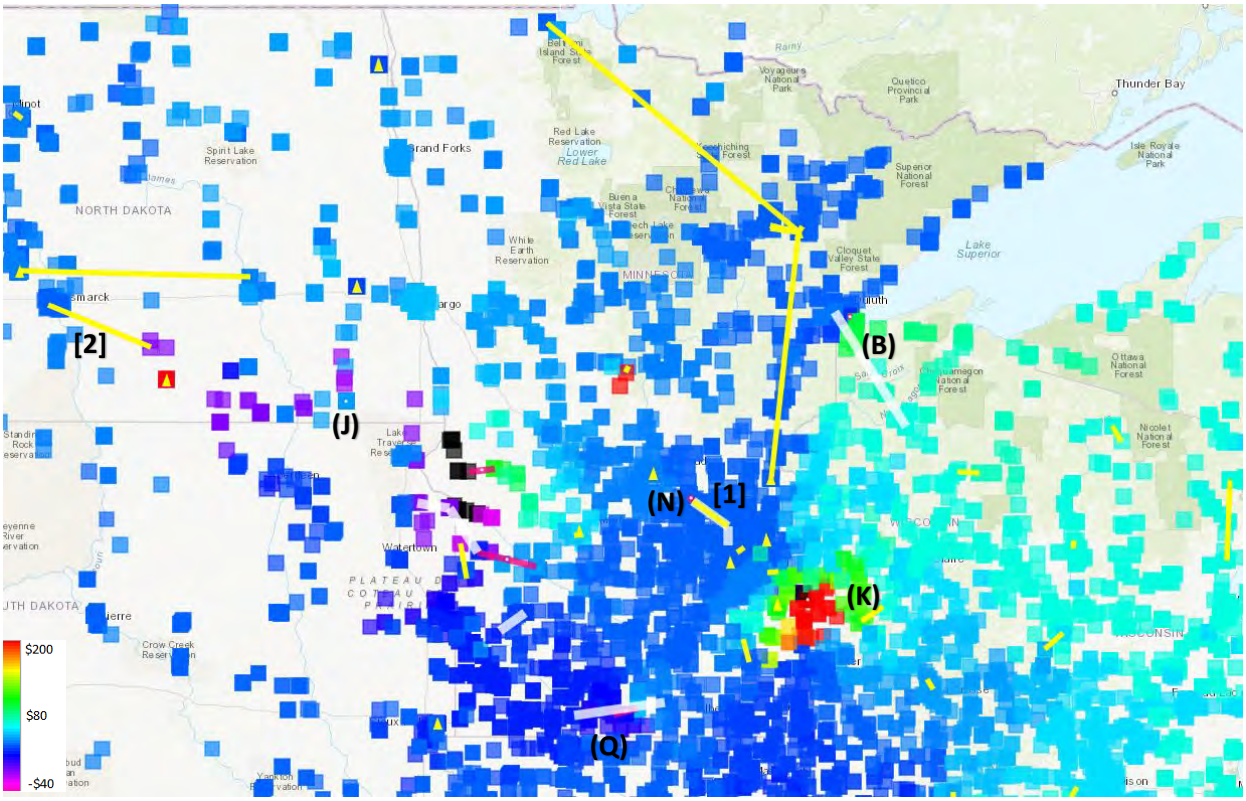
Week of 9/5/2022 Most congested hour 9/5/2022 8:00

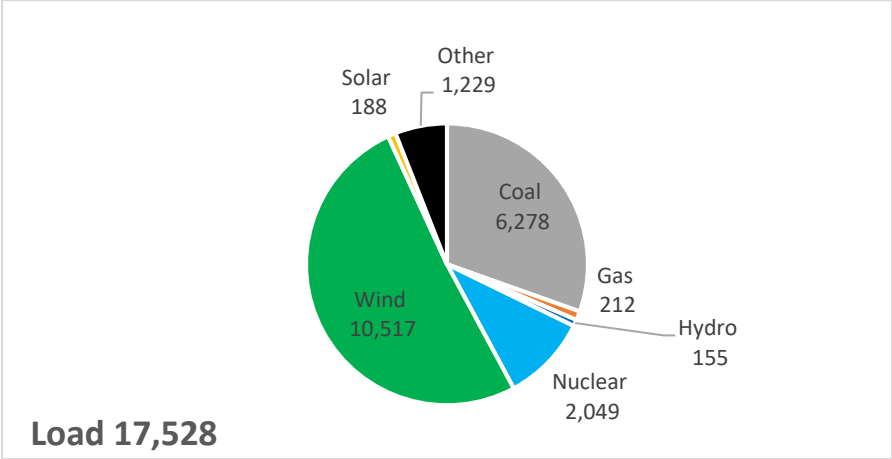




Wind generation is moderate and load is a moderate morning peak. The biggest constraints are:
(A) Cleveland to Le Center 69 kV in the event of an outage of Wilmarth to Sheas Lake 345 kV
(B) Hibbard to Winter Street 115 kV in the event of an outage of Arrowhead to Gary 115 kV (managed by the Stinson phase shifting transformer, which the analytical tool is unable to model)
(J) Forman 345/115 kV transformer in the event of an outage of Twin Brooks to Big Stone South kV
(N) Monticello to Sherco 345 kV in the event of an outage of Elm Creek to Parkers Lake 345 kV
CROW Outages significantly impacting congestion:
[1] Elm Creek to Monticello 345 kV
[2] Mandan to Napoleon 230 kV

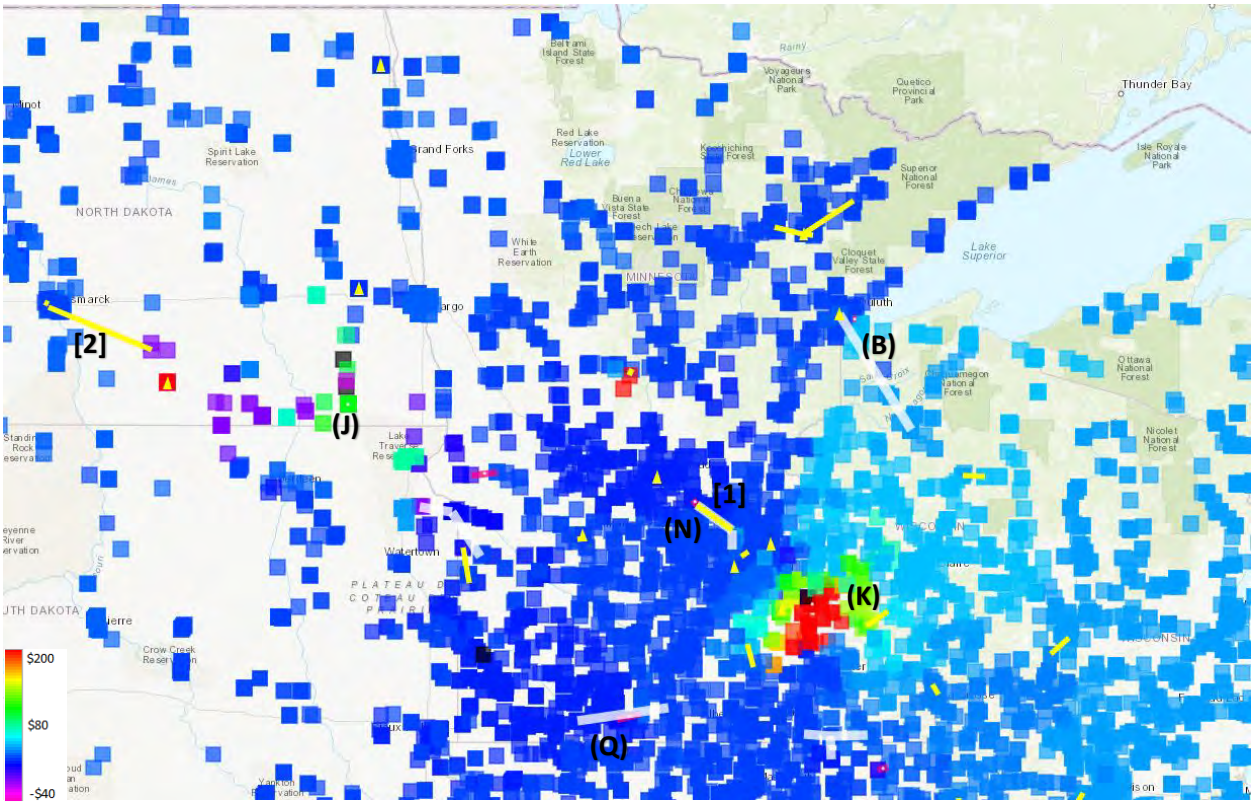
Week of 9/12/2022 Most congested hour 9/16/2022 8:00

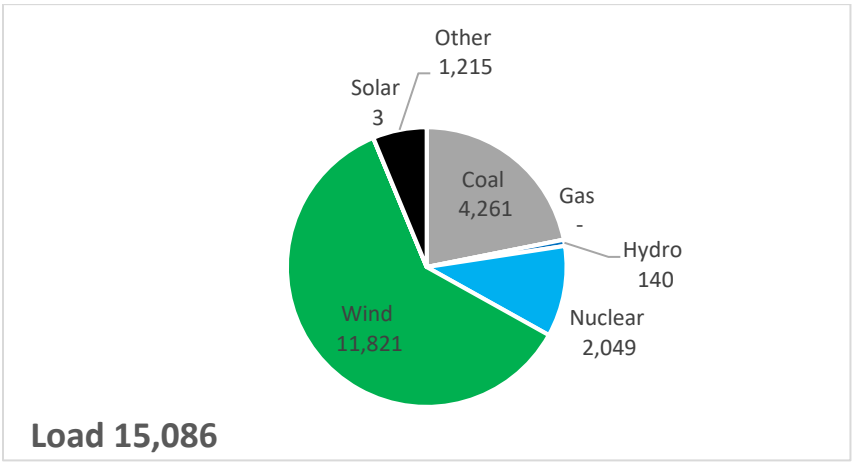




Wind generation is high and load is a moderate morning peak. The biggest constraints are:
(B) Hibbard to Winter Street 115 kV in the event of an outage of Arrowhead to Stone Lake 345 kV
(managed by the Stinson phase shifting transformer, which the analytical tool is unable to model)
(J) Forman 345/115 kV transformer in the event of an outage of Twin Brooks to Big Stone South kV
(K) Spring Creek 161/69 kV transformer in the event of an outage of Spring Creek parallel transformer
(N) Monticello to Sherco 345 kV in the event of an outage of Elm Creek to Parkers Lake 345 kV
(Q) Rutland to Fox Lake 161 kV in the event of an outage of Lakefield to Huntley 345 kV
CROW Outages significantly impacting congestion:
[1] Elm Creek to Monticello 345 kV
[2] Mandan to Napoleon 230 kV

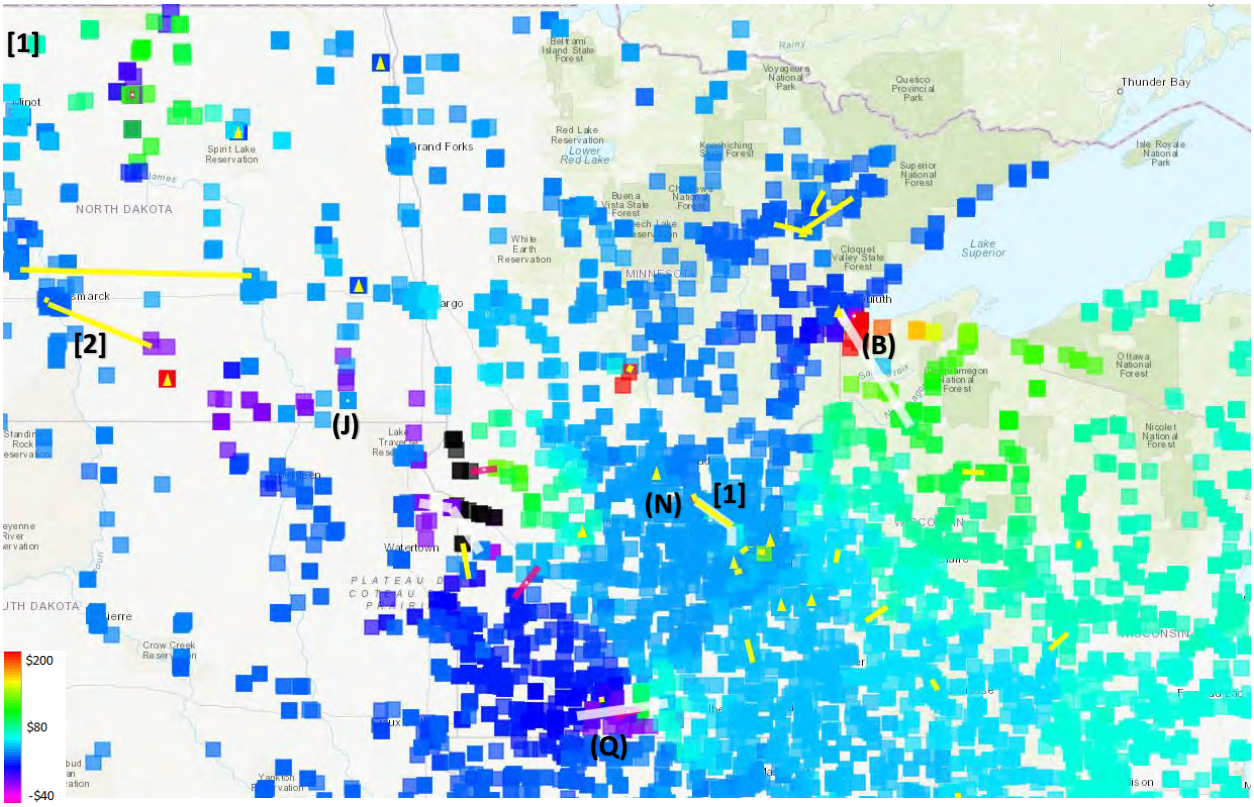
Week of 9/19/2022 Most congested hour 9/24/2022 7:00

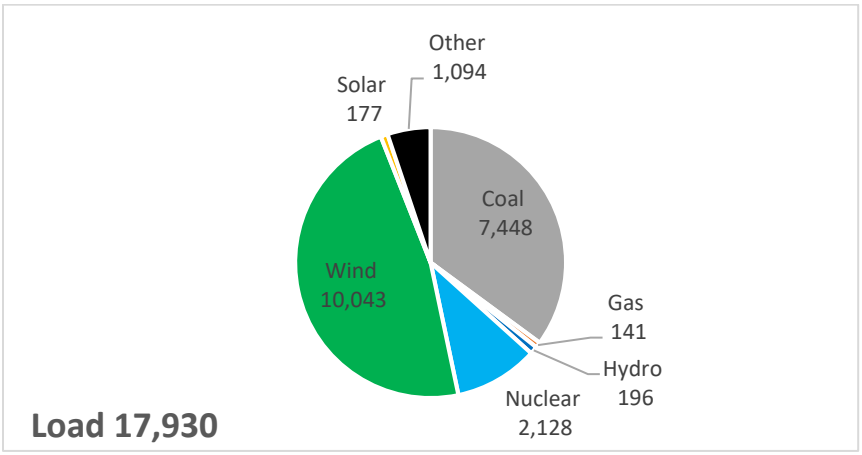




Wind generation is high and load is a low morning load. The biggest constraints are:
(B) Hibbard to Winter Street 115 kV in the event of an outage of Arrowhead to Stone Lake 345 kV
(managed by the Stinson phase shifting transformer, which the analytical tool is unable to model)
(J) Forman 345/115 kV transformer in the event of an outage of Twin Brooks to Big Stone South kV
(K) Spring Creek 161/69 kV transformer in the event of an outage of Spring Creek parallel transformer
(N) Monticello to Sherco 345 kV in the event of an outage of Elm Creek to Parkers Lake 345 kV
(Q) Rutland to Fox Lake 161 kV in the event of an outage of Lakefield to Huntley 345 kV
CROW Outages significantly impacting congestion:
[1] Elm Creek to Monticello 345 kV
[2] Mandan to Napoleon 230 kV

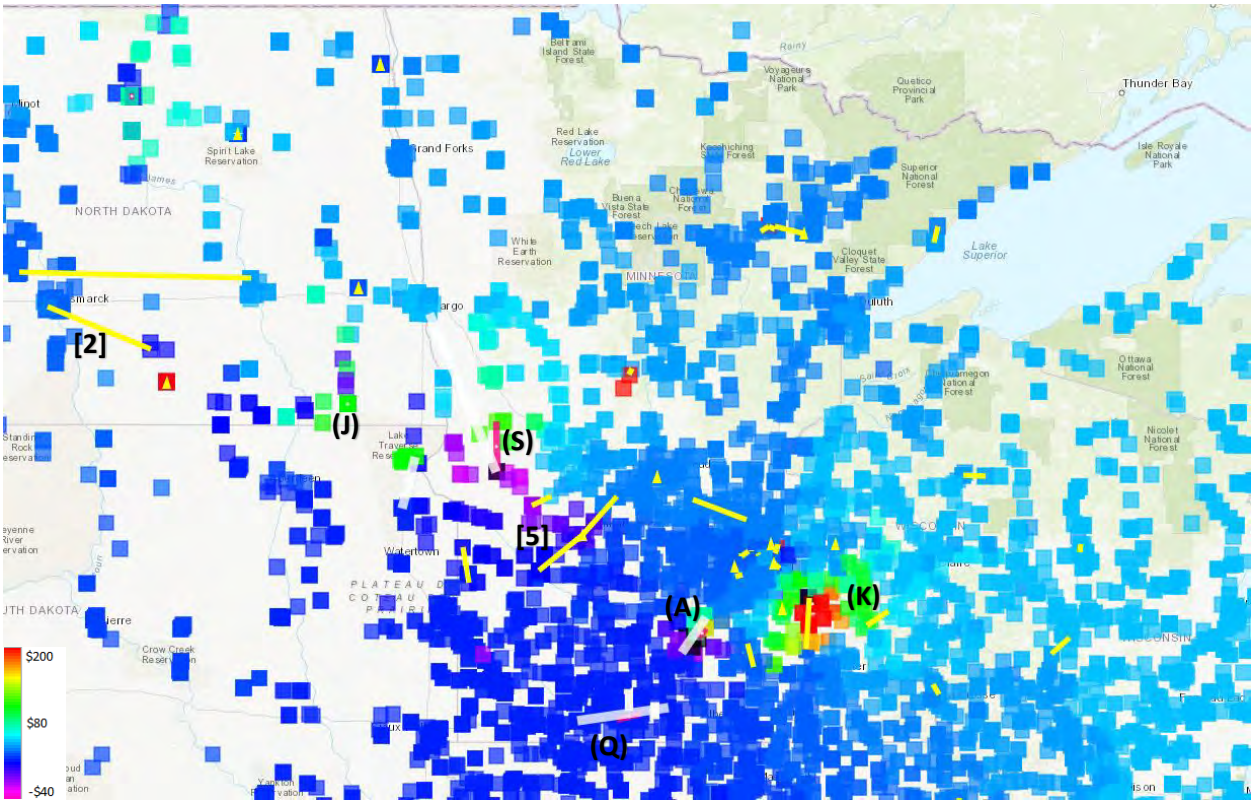
Week of 9/26/2022 Most congested hour 9/26/2022 18:00

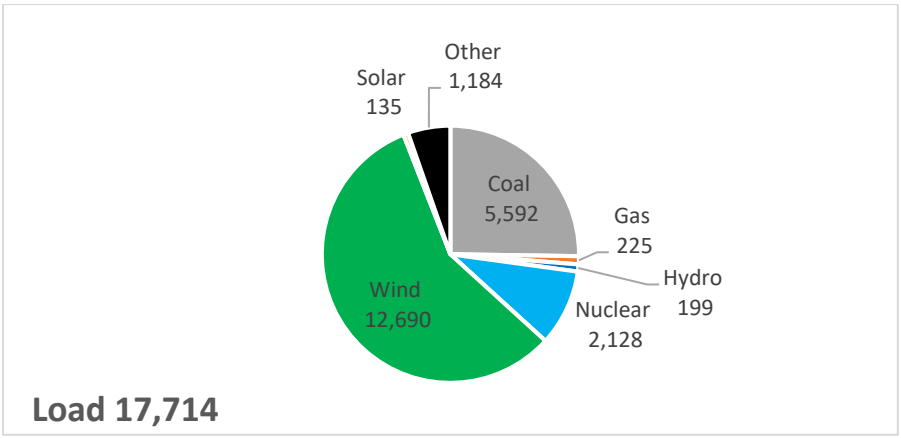




Wind generation is high and load is a moderate evening peak. The biggest constraints are:
(B) Hibbard to Winter Street 115 kV in the event of an outage of Arrowhead to Stone Lake 345 kV
(managed by the Stinson phase shifting transformer, which the analytical tool is unable to model)
(J) Forman 345/115 kV transformer in the event of an outage of Twin Brooks to Big Stone South kV
(N) Monticello to Sherco 345 kV in the event of an outage of Elm Creek to Parkers Lake 345 kV
(Q) Rutland to Fox Lake 161 kV in the event of an outage of Lakefield to Huntley 345 kV
CROW Outages significantly impacting congestion:
[1] Elm Creek to Monticello 345 kV
[2] Mandan to Napoleon 230 kV

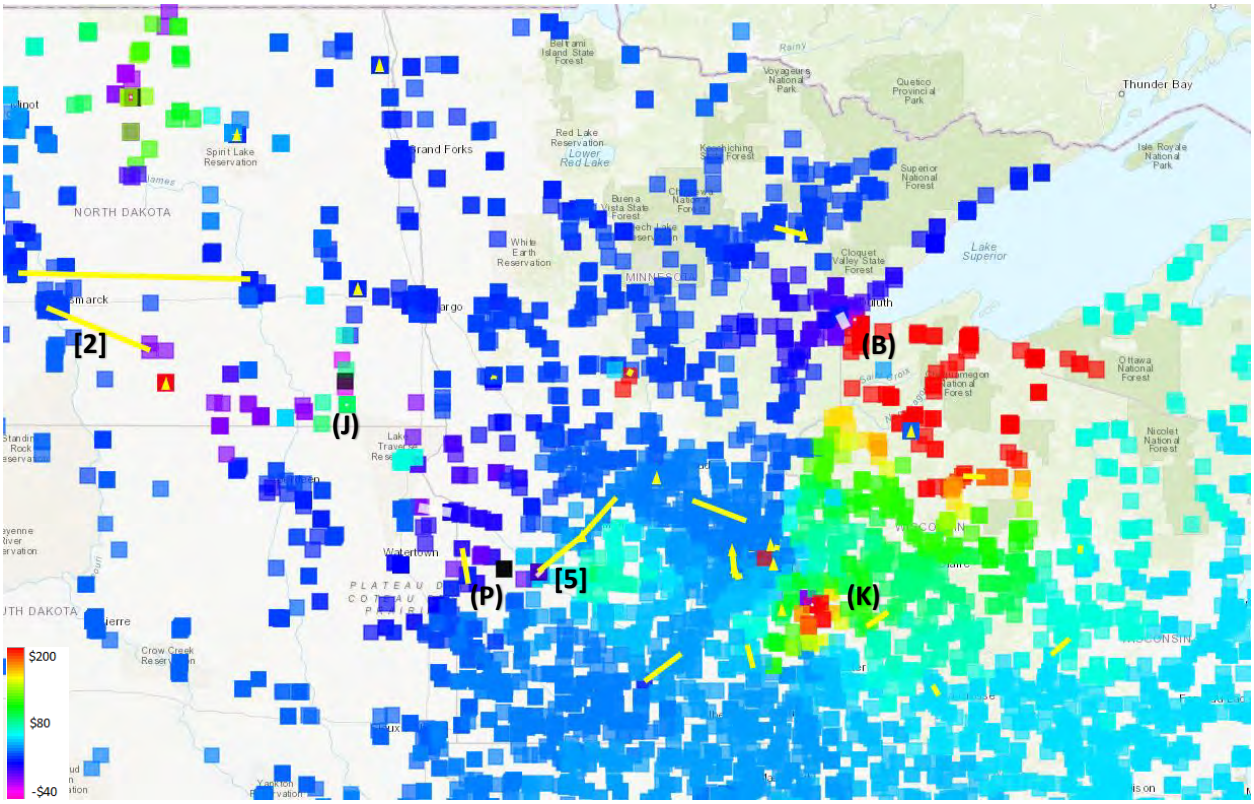
Week of 10/3/2022 Most congested hour 10/6/2022 8:00

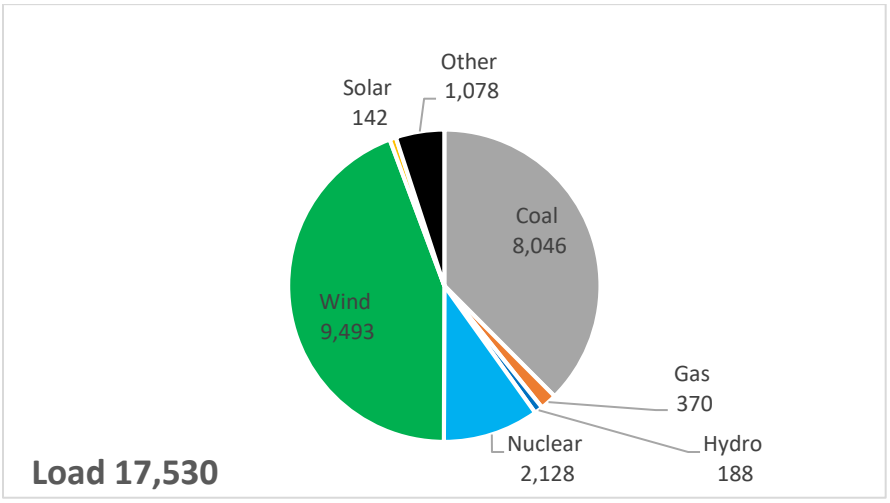




Wind generation is high and load is a moderate morning peak. The biggest constraints are:
(A) Cleveland to Le Center 69 kV in the event of an outage of Wilmarth to Sheas Lake 345 kV
(J) Forman 345/115 kV transformer in the event of an outage of Twin Brooks to Big Stone South kV
(K) Spring Creek 161/69 kV transformer in the event of an outage of Spring Creek parallel transformer
(Q) Rutland to Fox Lake 161 kV in the event of an outage of Lakefield to Huntley 345 kV
(S) Morris to Grant County 115 kV in the event of an outage of Moorhead to Morris 230 kV
CROW Outages significantly impacting congestion:
[2] Mandan to Napoleon 230 kV
[5] Granite Falls to Willmar to Paynesville 230 kV

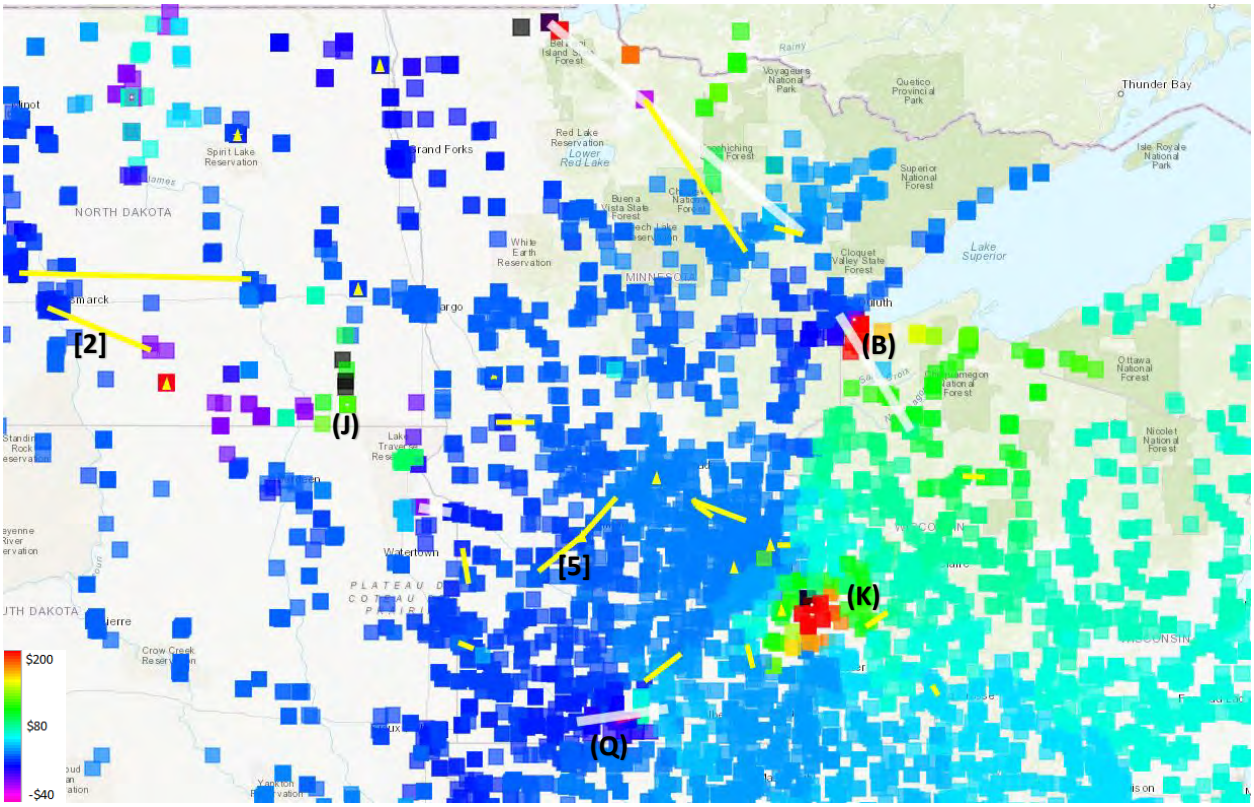
Week of 10/10/2022 Most congested hour 10/13/2022 10:00

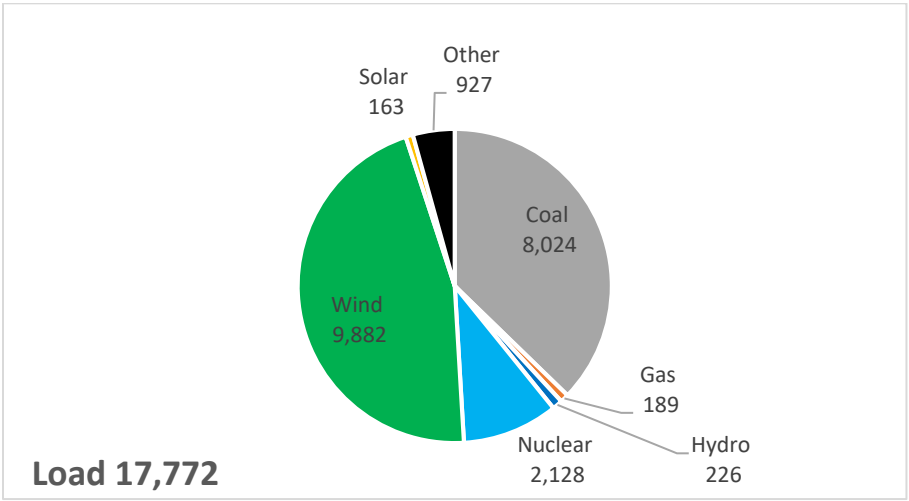




Wind generation is moderate and load is a moderate morning peak. The biggest constraints are:
(B) Hibbard to Winter Street 115 kV in the event of an outage of Arrowhead to Gary 115 kV (managed by the Stinson phase shifting transformer, which the analytical tool is unable to model)
(J) Forman 345/115 kV transformer in the event of an outage of Twin Brooks to Big Stone South kV
(K) Spring Creek 161/69 kV transformer in the event of an outage of Spring Creek parallel transformer
(P) Minn Valley to Granite Falls 230 kV in the event of an outage of Minn Valley Tap to Granite Falls 230
CROW Outages significantly impacting congestion:
[2] Mandan to Napoleon 230 kV
[5] Granite Falls to Willmar to Paynesville 230 kV

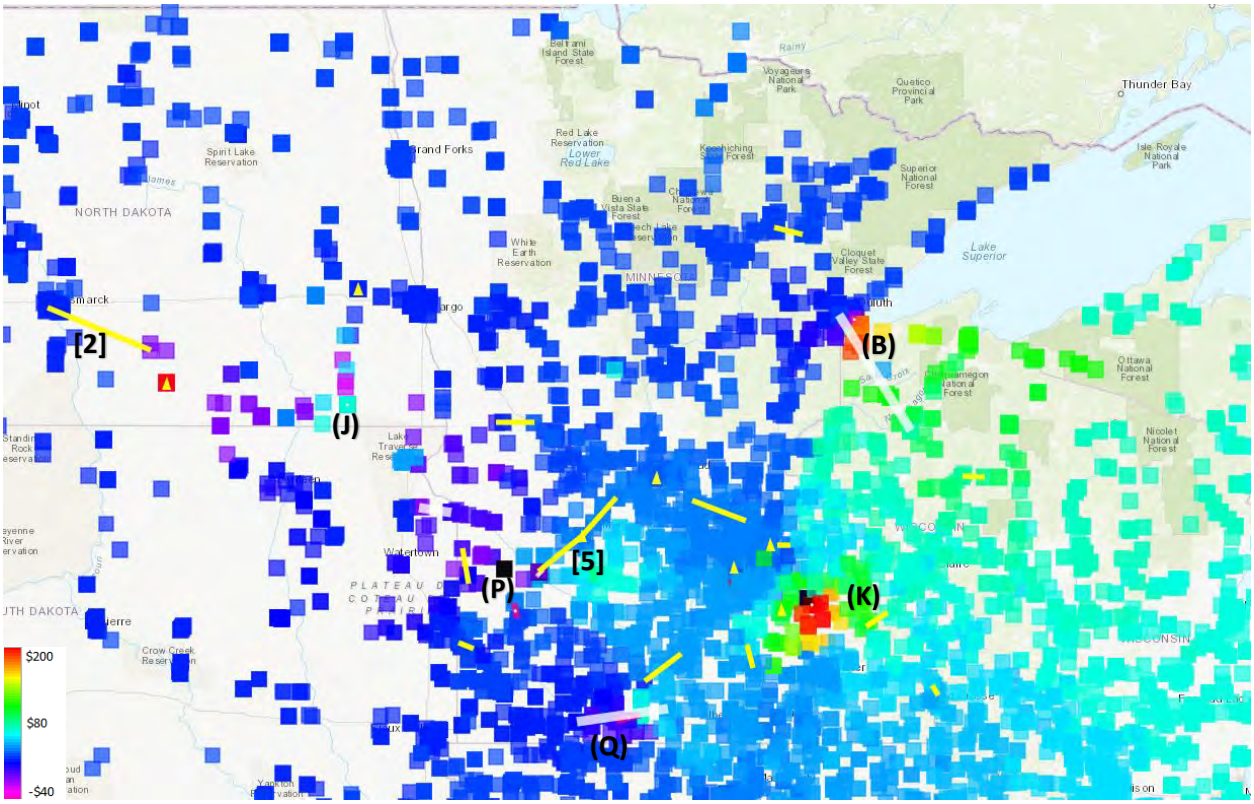
Week of 10/17/2022 Most congested hour 10/18/2022 18:00

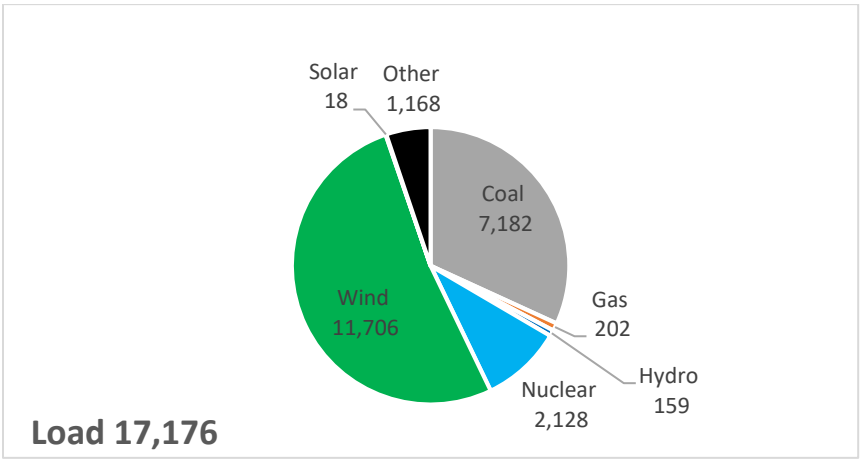




Wind generation is moderate and load is a moderate evening peak. The biggest constraints are:
(B) Hibbard to Winter Street 115 kV in the event of an outage of Arrowhead to Stone Lake 345 kV
(managed by the Stinson phase shifting transformer, which the analytical tool is unable to model)
(J) Forman 345/115 kV transformer in the event of an outage of Twin Brooks to Big Stone South kV
(K) Spring Creek 161/69 kV transformer in the event of an outage of Spring Creek parallel transformer
(Q) Rutland to Fox Lake 161 kV in the event of an outage of Lakefield to Huntley 345 kV
CROW Outages significantly impacting congestion:
[2] Mandan to Napoleon 230 kV
[5] Granite Falls to Willmar to Paynesville 230 kV

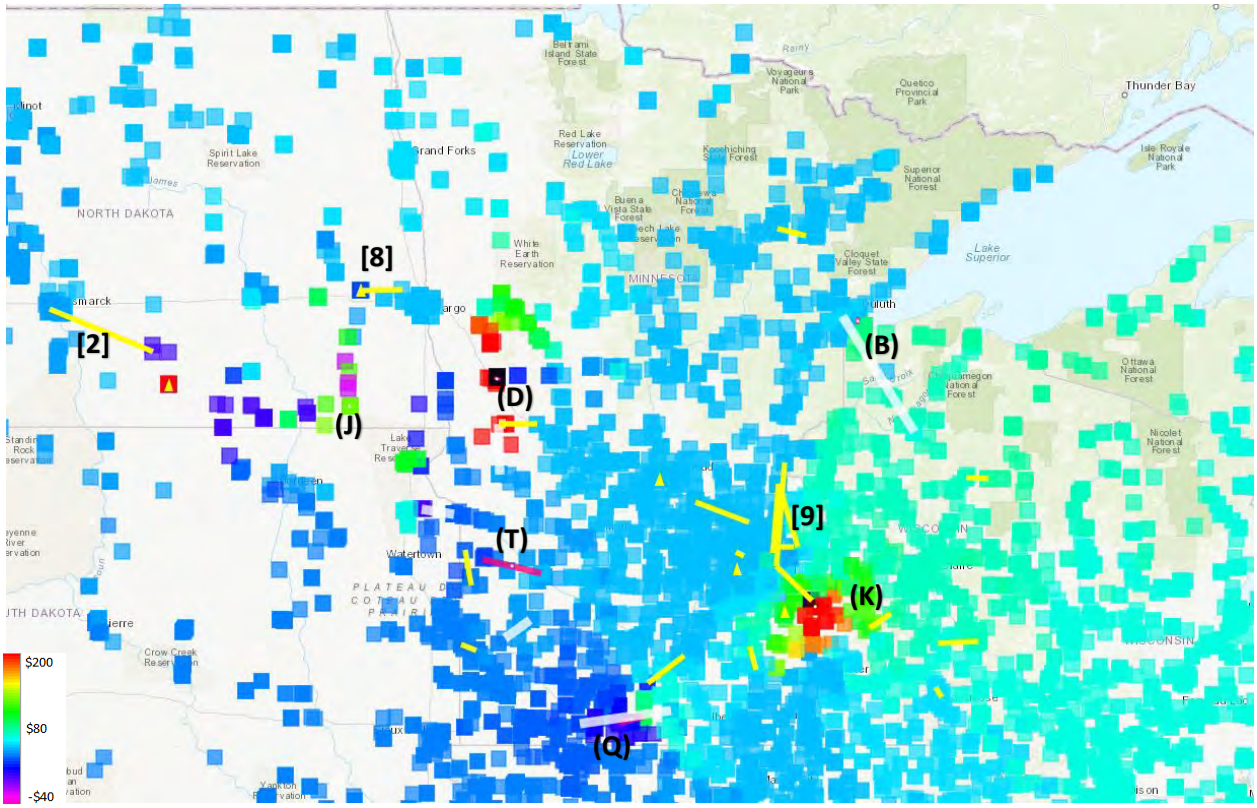
Week of 10/24/2022 Most congested hour 10/24/2022 6:00

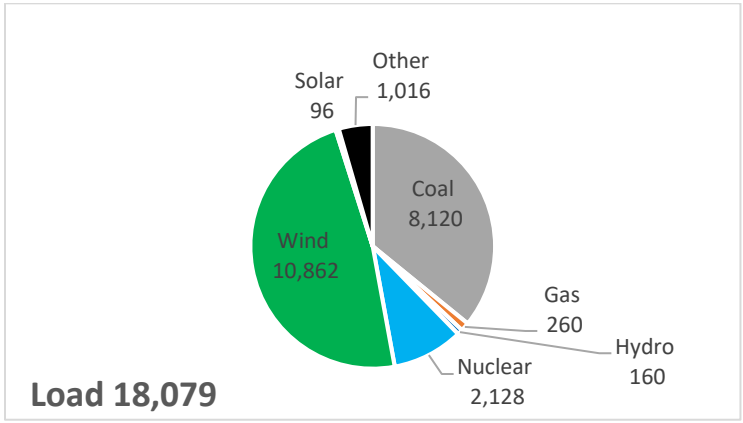




Wind generation is high and load is a moderate morning load. The biggest constraints are:
(B) Hibbard to Winter Street 115 kV in the event of an outage of Arrowhead to Stone Lake 345 kV
(managed by the Stinson phase shifting transformer, which the analytical tool is unable to model)
(J) Forman 345/115 kV transformer in the event of an outage of Twin Brooks to Big Stone South kV
(K) Spring Creek 161/69 kV transformer in the event of an outage of Spring Creek parallel transformer
(P) Minn Valley to Granite Falls 230 kV in the event of an outage of Minn Valley Tap to Granite Falls 230
(Q) Rutland to Fox Lake 161 kV in the event of an outage of Lakefield to Huntley 345 kV
CROW Outages significantly impacting congestion:
[2] Mandan to Napoleon 230 kV
[5] Granite Falls to Willmar to Paynesville 230 kV

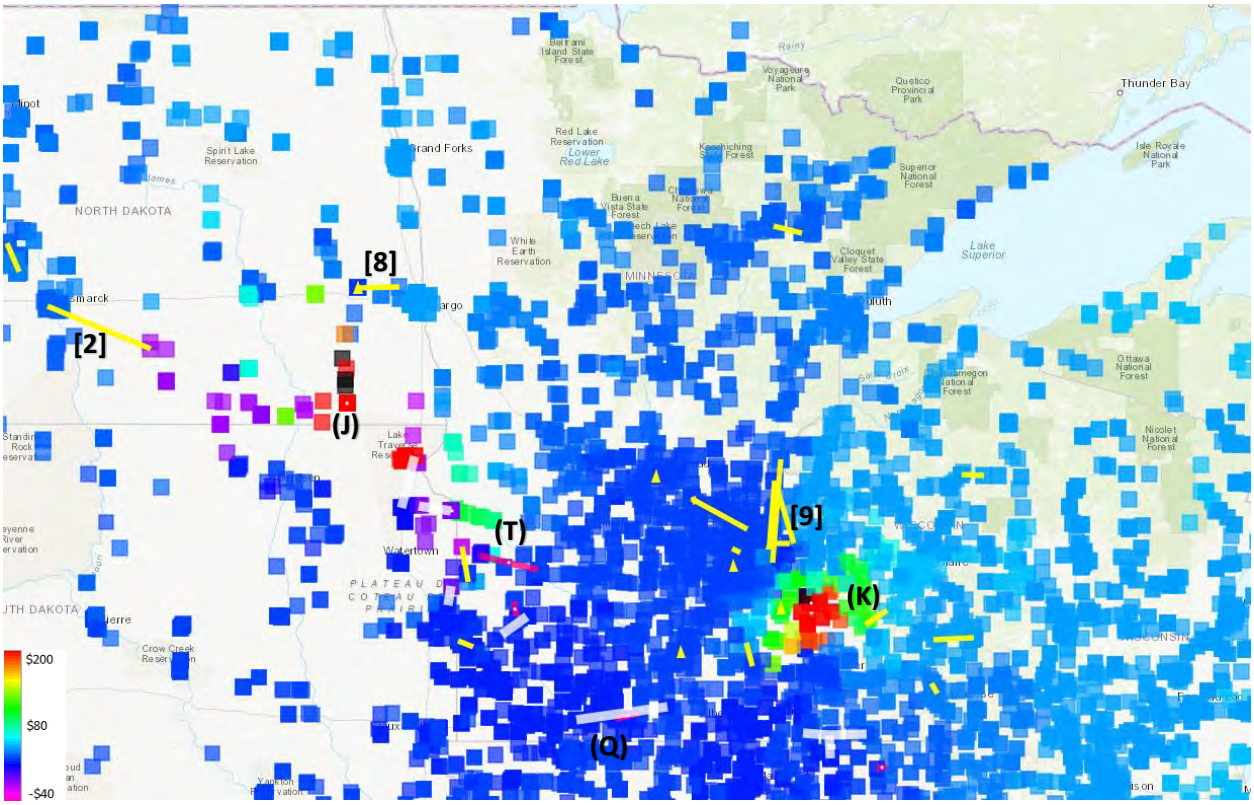
Week of 10/31/2022 Most congested hour 11/2/2022 9:00

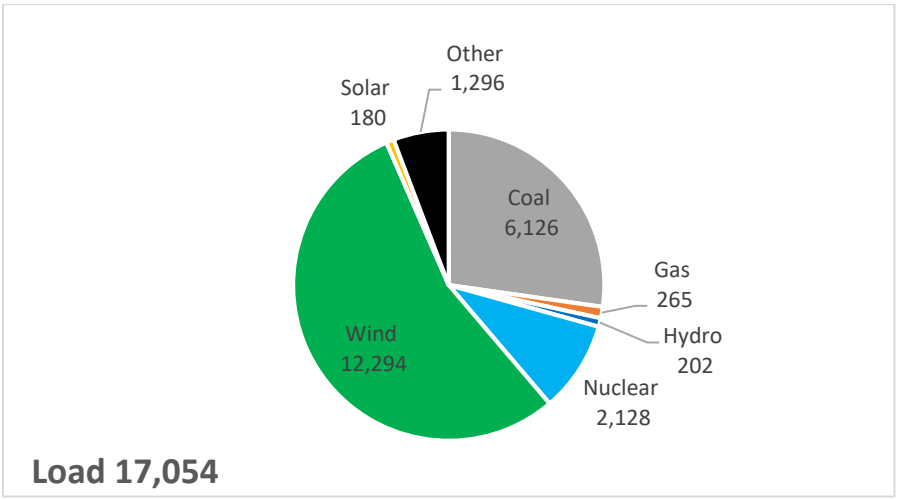




Wind generation is high and load is a moderate morning peak. The biggest constraints are:
(B) Hibbard to Winter Street 115 kV in the event of an outage of Arrowhead to Stone Lake 345 kV(managed by the Stinson phase shifting transformer, which the analytical tool is unable to model)
(D) Hoot Lake to Fergus Falls 115 kV in the event of an outage of Fergus Falls to Silver Lake 230 kV
(J) Forman 345/115 kV transformer in the event of an outage of Twin Brooks to Big Stone South kV
(K) Spring Creek 161/69 kV transformer in the event of an outage of Spring Creek parallel transformer
(Q) Rutland to Fox Lake 161 kV in the event of an outage of Lakefield to Huntley 345 kV
(T) Granite Falls to Blair 230 kV in the event of an outage of Hawks Nest to Lyon County 345 kV
CROW Outages significantly impacting congestion:
[2] Mandan to Napoleon 230 kV
[8] Buffalo to Bison 345 kV
[9] Chisago County to King 345 kV and Chisago County to Kohlman Lake 345 kV

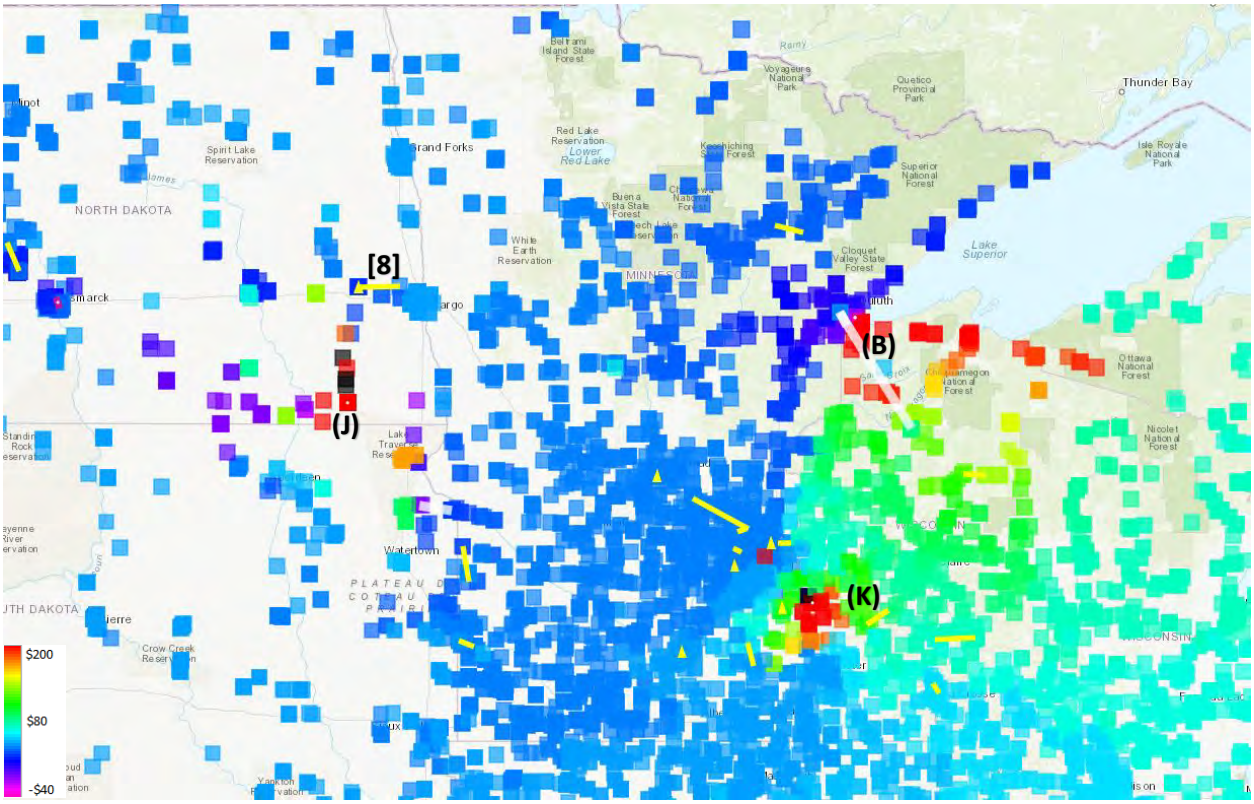
Week of 11/7/2022 Most congested hour 11/12/2022 13:00

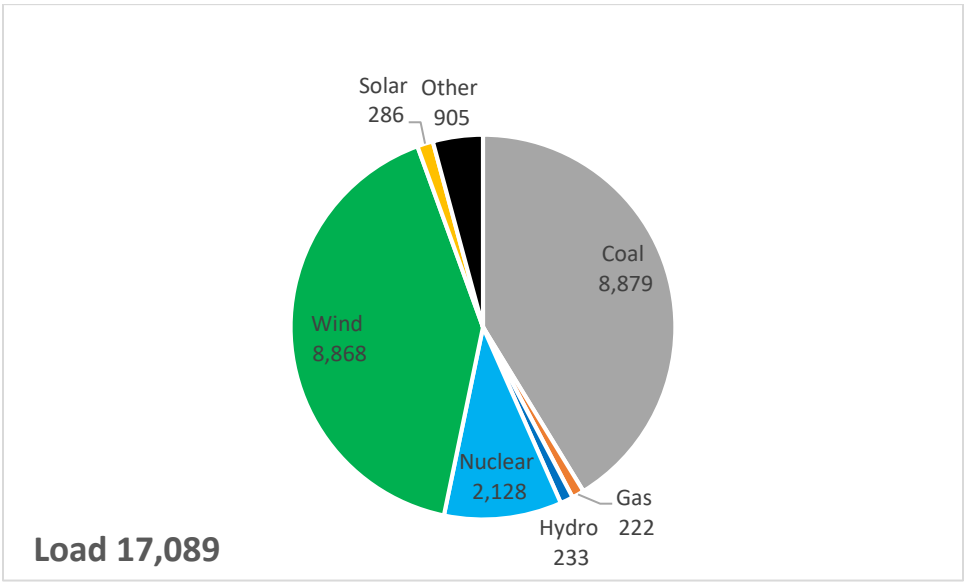




Wind generation is high and load is a moderate mid-day load. The biggest constraints are:
(J) Forman 345/115 kV transformer in the event of an outage of Twin Brooks to Big Stone South kV
(K) Spring Creek 161/69 kV transformer in the event of an outage of Spring Creek parallel transformer
(Q) Rutland to Fox Lake 161 kV in the event of an outage of Lakefield to Huntley 345 kV
(T) Granite Falls to Blair 230 kV in the event of an outage of Hawks Nest to Lyon County 345 kV
CROW Outages significantly impacting congestion:
[2] Mandan to Napoleon 230 kV
[8] Buffalo to Bison 345 kV
[9] Chisago County to King 345 kV and Chisago County to Kohlman Lake 345 kV

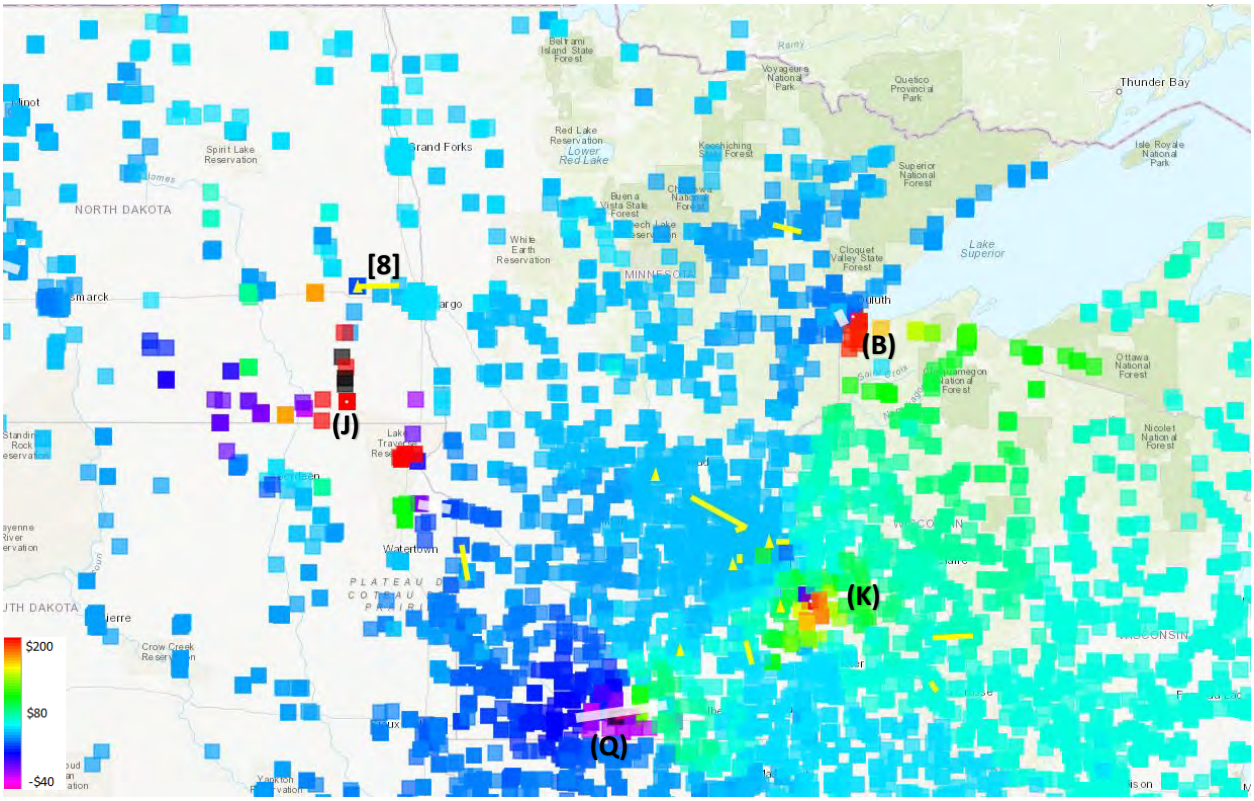
Week of 11/14/2022 Most congested hour 11/17/2022 11:00

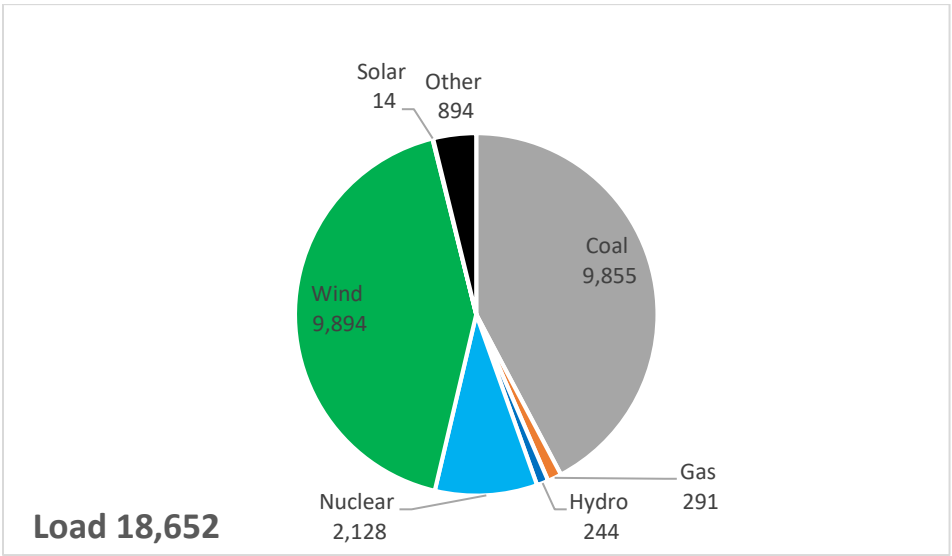




Wind generation is moderate and load is a moderate mid-day load. The biggest constraints are:
(B) Hibbard to Winter Street 115 kV in the event of an outage of Arrowhead to Stone Lake 345 kV (managed by the Stinson phase shifting transformer, which the analytical tool is unable to model)
(J) Forman 345/115 kV transformer in the event of an outage of Twin Brooks to Big Stone South kV
(K) Spring Creek 161/69 kV transformer in the event of an outage of Spring Creek parallel transformer
CROW Outages significantly impacting congestion:
[8] Buffalo to Bison 345 kV

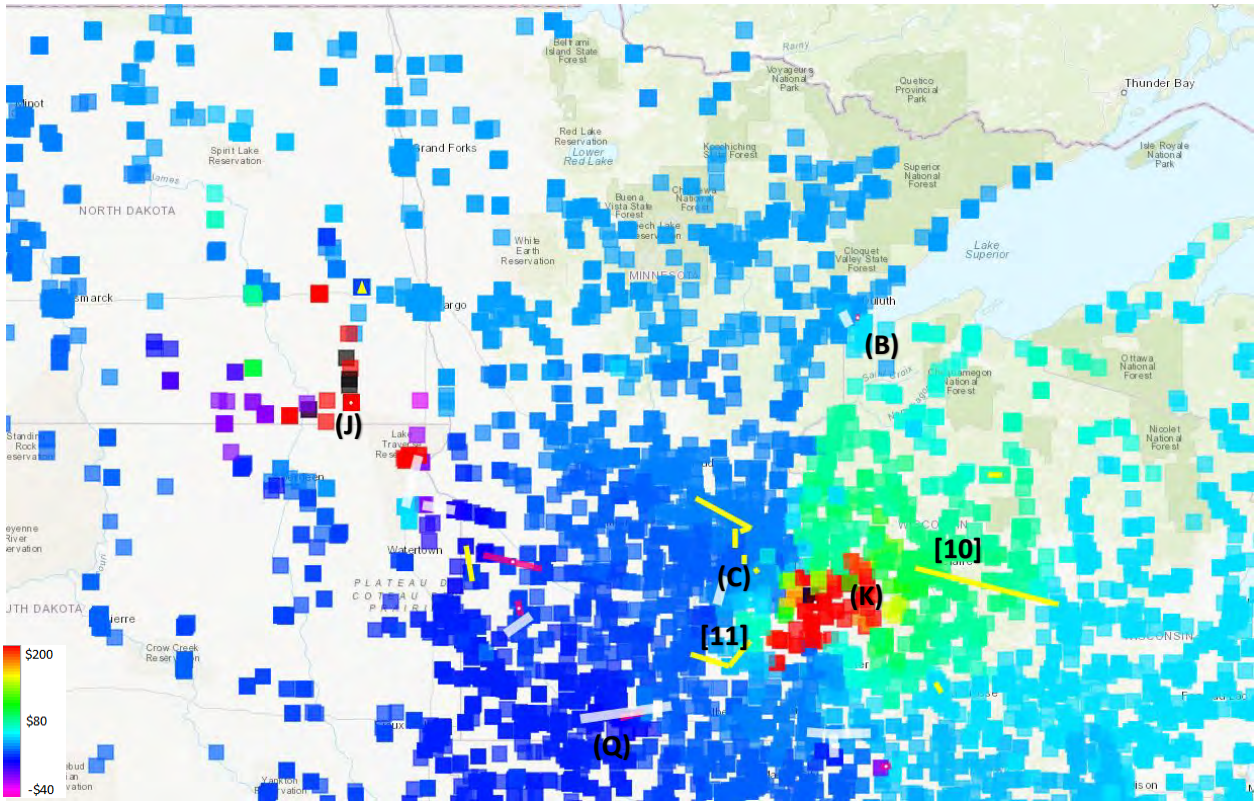
Week of 11/21/2022 Most congested hour 11/22/2022 8:00

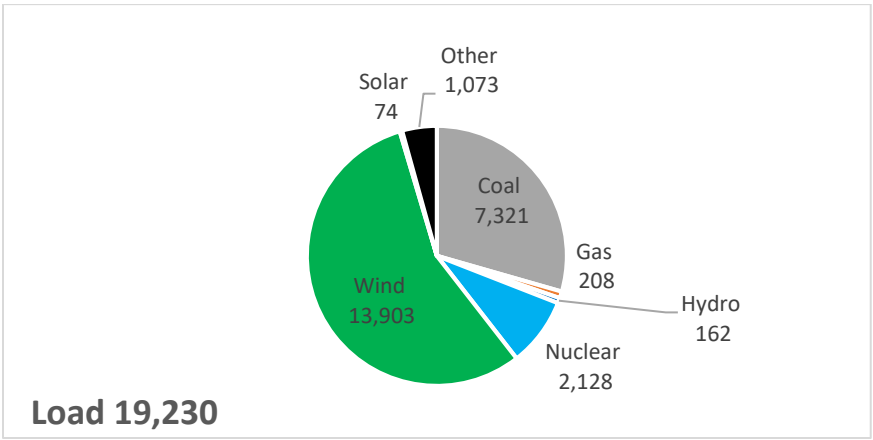




Wind generation is moderate and load is a moderate morning peak. The biggest constraints are:
(B) Hibbard to Winter Street 115 kV in the event of an outage of Arrowhead to Gary 115 kV (managed by the Stinson phase shifting transformer, which the analytical tool is unable to model)
(J) Forman 345/115 kV transformer in the event of an outage of Twin Brooks to Big Stone South kV
(K) Spring Creek 161/69 kV transformer in the event of an outage of Spring Creek parallel transformer
(Q) Rutland to Fox Lake 161 kV in the event of an outage of Lakefield to Huntley 345 kV
CROW Outages significantly impacting congestion:
[8] Buffalo to Bison 345 kV

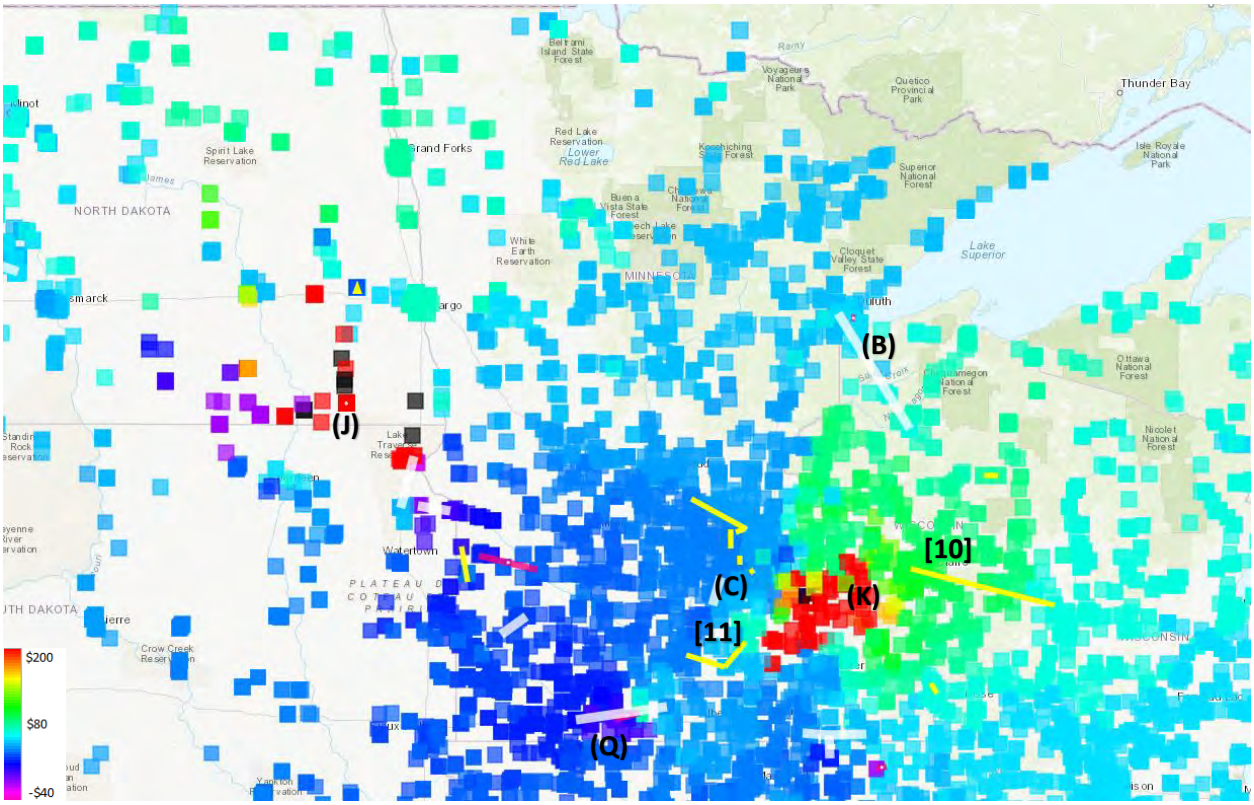
Week of 11/28/2022 Most congested hour 12/4/2022 21:00

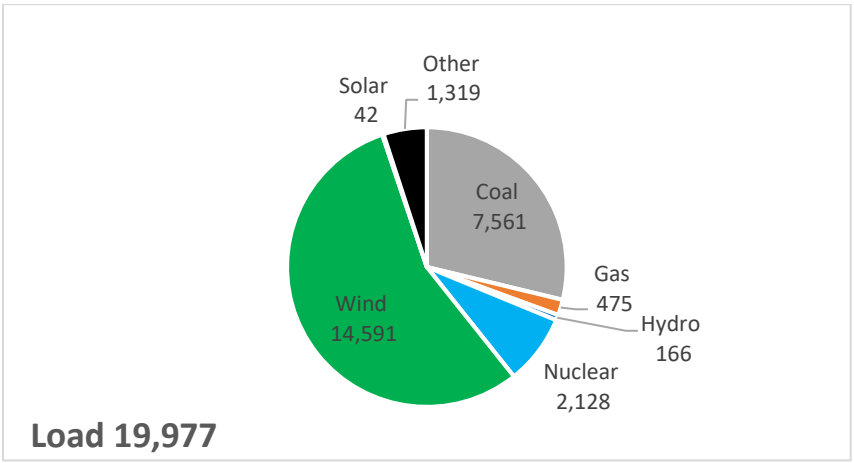




Wind generation is high and load is a moderate evening peak. The biggest constraints are:
(B) Hibbard to Winter Street 115 kV in the event of an outage of Arrowhead to Gary 115 kV (managed by the Stinson phase shifting transformer, which the analytical tool is unable to model)
(C) Chub Lake 345/115 kV transformer in the event of an outage of Helena to Scott County 345 kV (being addressed in MTEP process)
(J) Forman 345/115 kV transformer in the event of an outage of Twin Brooks to Big Stone South kV
(K) Spring Creek 161/69 kV transformer in the event of an outage of Spring Creek parallel transformer
(Q) Rutland to Fox Lake 161 kV in the event of an outage of Lakefield to Huntley 345 kV
CROW Outages significantly impacting congestion:
[10] Eau Claire to Arpin 345 kV
[11] Eastwood to Loon Lake Tap to West Faribault 115 kV

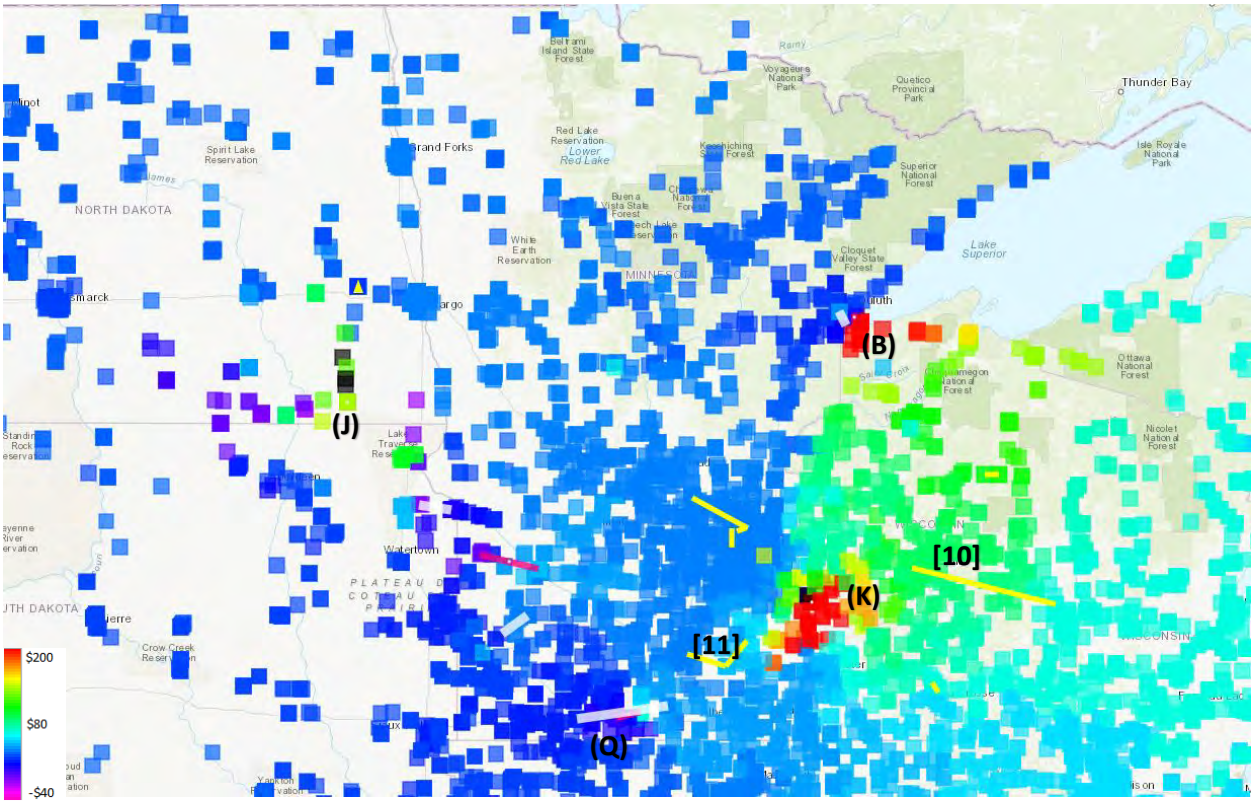
Week of 12/5/2022 Most congested hour 12/5/2022 8:00

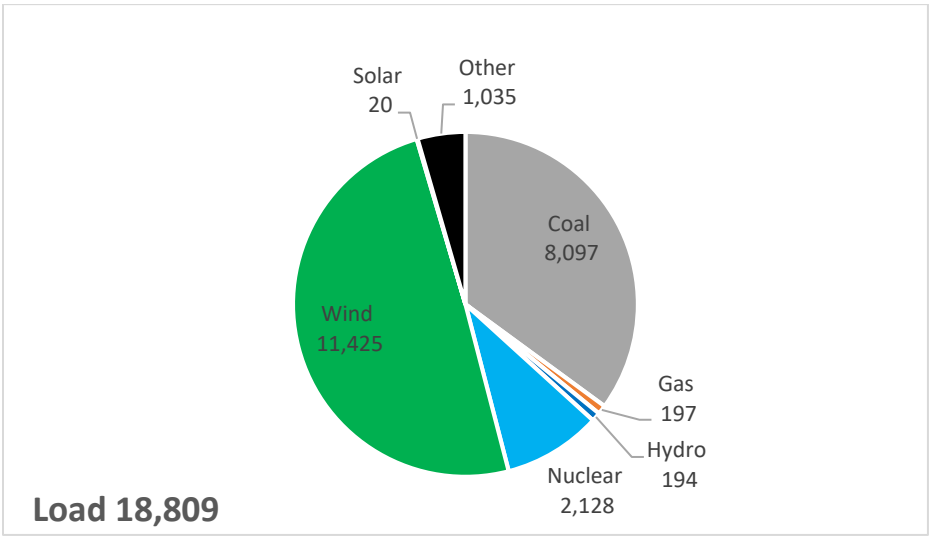




Wind generation is high and load is a high morning peak. The biggest constraints are:
(B) Hibbard to Winter Street 115 kV in the event of an outage of Arrowhead to Stone Lake 345 kV (managed by the Stinson phase shifting transformer, which the analytical tool is unable to model)
(C) Chub Lake 345/115 kV transformer in the event of an outage of Helena to Scott County 345 kV (being addressed in MTEP process)
(J) Forman 345/115 kV transformer in the event of an outage of Twin Brooks to Big Stone South kV
(K) Spring Creek 161/69 kV transformer in the event of an outage of Spring Creek parallel transformer
(Q) Rutland to Fox Lake 161 kV in the event of an outage of Lakefield to Huntley 345 kV
CROW Outages significantly impacting congestion:
[10] Eau Claire to Arpin 345 kV
[11] Eastwood to Loon Lake Tap to West Faribault 115 kV

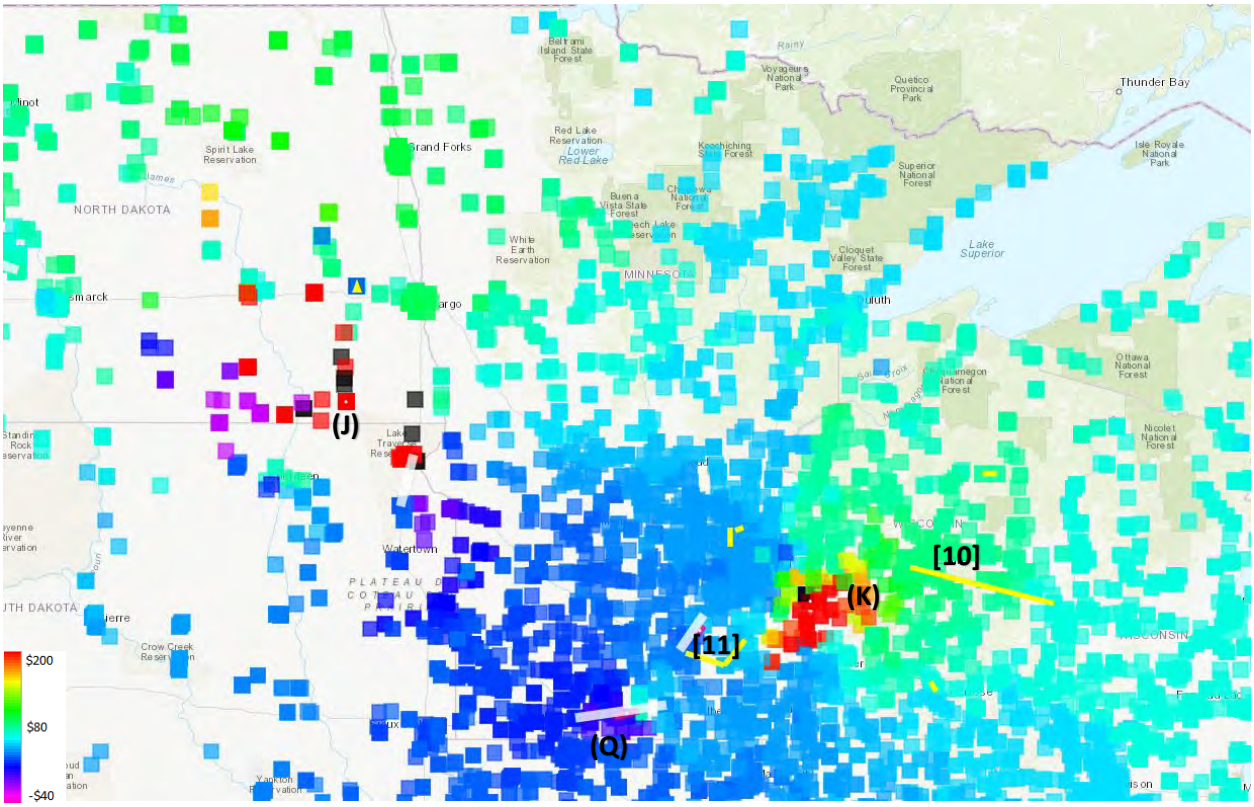
Week of 12/12/2022 Most congested hour 12/18/2022 18:00

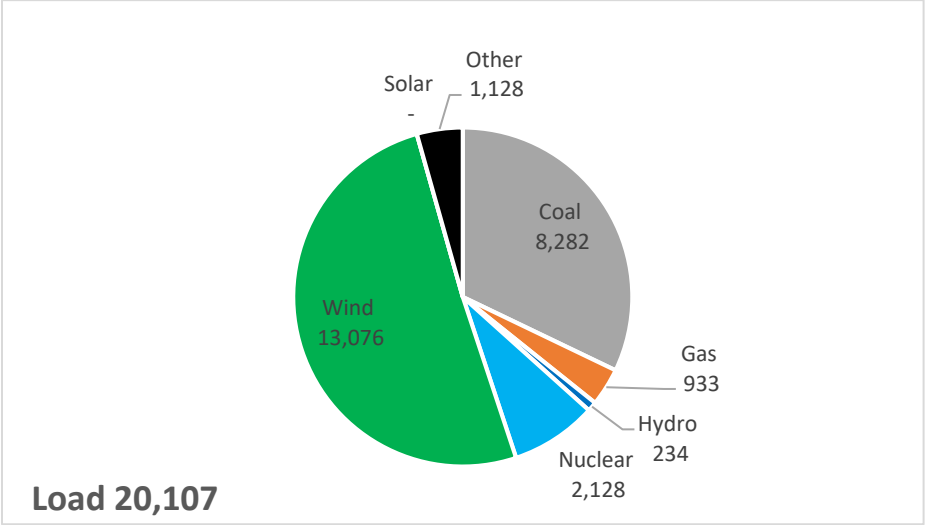




Wind generation is high and load is a moderate evening peak. The biggest constraints are:
(B) Hibbard to Winter Street 115 kV in the event of an outage of Arrowhead to Gary 115 kV (managed by the Stinson phase shifting transformer, which the analytical tool is unable to model)
(J) Forman 345/115 kV transformer in the event of an outage of Twin Brooks to Big Stone South kV
(K) Spring Creek 161/69 kV transformer in the event of an outage of Spring Creek parallel transformer
(Q) Rutland to Fox Lake 161 kV in the event of an outage of Lakefield to Huntley 345 kV
CROW Outages significantly impacting congestion:
[10] Eau Claire to Arpin 345 kV
[11] Eastwood to Loon Lake Tap to West Faribault 115 kV

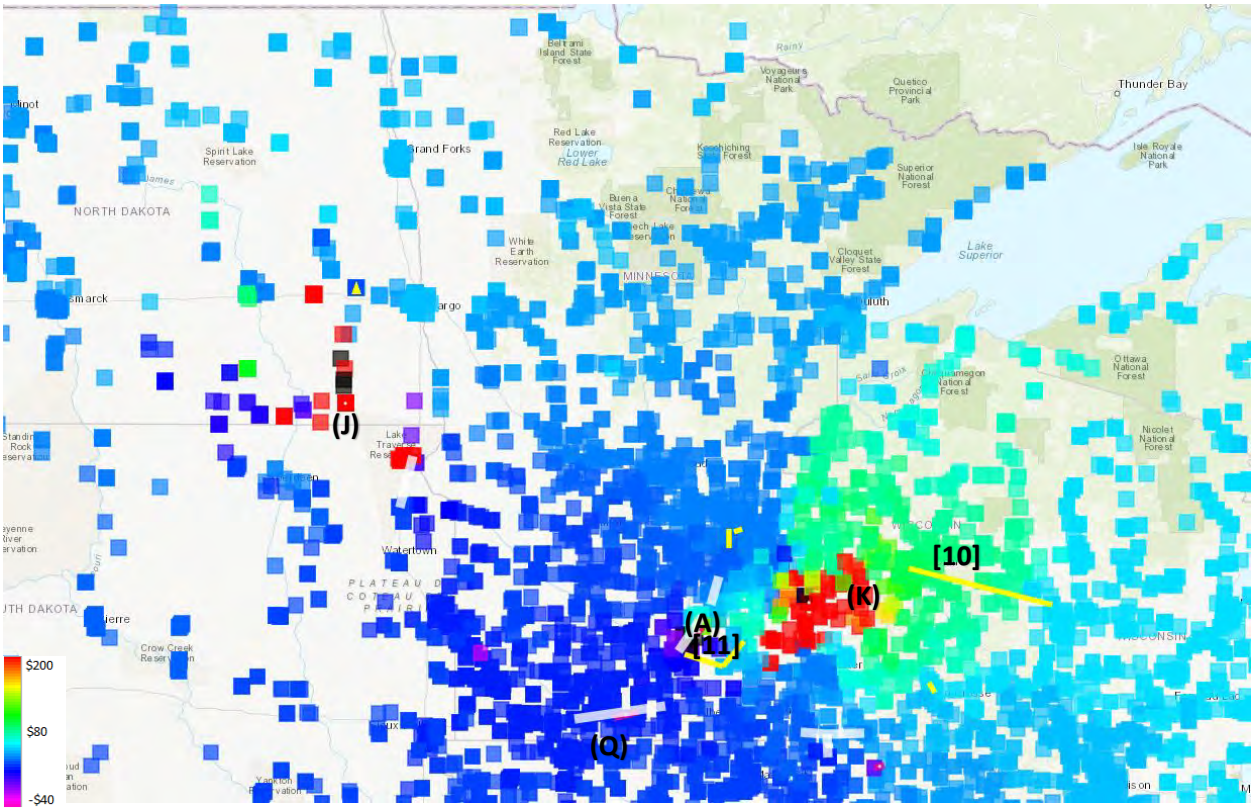
Week of 12/19/2022 Most congested hour 12/23/2022 18:00

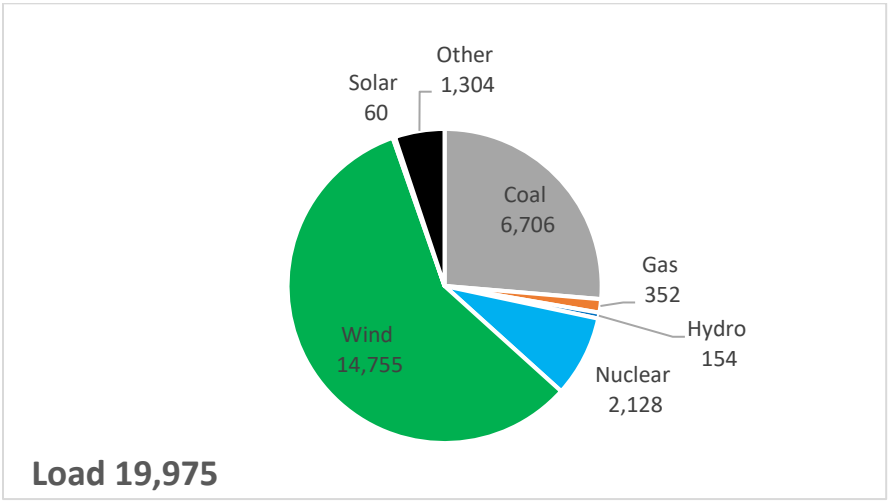




Wind generation is high and load is a high evening peak. The biggest constraints are:
(A) Cleveland to Le Center 69 kV in the event of an outage of Wilmarth to Sheas Lake 345 kV
(J) Forman 345/115 kV transformer in the event of an outage of Twin Brooks to Big Stone South kV
(K) Spring Creek 161/69 kV transformer in the event of an outage of Spring Creek parallel transformer
(Q) Rutland to Fox Lake 161 kV in the event of an outage of Lakefield to Huntley 345 kV
CROW Outages significantly impacting congestion:
[10] Eau Claire to Arpin 345 kV
[11] Eastwood to Loon Lake Tap to West Faribault 115 kV

Week of 12/26/2022 Most congested hour 12/29/2022 22:00





Wind generation is high and load is a high evening peak. The biggest constraints are:
(A) Cleveland to Le Center 69 kV in the event of an outage of Wilmarth to Sheas Lake 345 kV
(C) Chub Lake 345/115 kV transformer in the event of an outage of Helena to Scott County 345 kV (being addressed in MTEP process)
(J) Forman 345/115 kV transformer in the event of an outage of Twin Brooks to Big Stone South kV
(K) Spring Creek 161/69 kV transformer in the event of an outage of Spring Creek parallel transformer
(Q) Rutland to Fox Lake 161 kV in the event of an outage of Lakefield to Huntley 345 kV
CROW Outages significantly impacting congestion:
[10] Eau Claire to Arpin 345 kV
[11] Eastwood to Loon Lake Tap to West Faribault 115 kV

Impact of Planned and Forced Outages

This table shows the most congested hour for each operating state and how the congestion in that hour compares to the baseline operating state. Impacts listed as “more than base” represent new and incremental congestion due to planned (CROW) and unplanned (Forced) outages.

Week Of	Hour	Shadow Sum System Intact	Shadow Sum CROW	Shadow Sum CROW+Forced	CROW Impact	CROW+Forced Impact
8/29/2022	8/29/2022 12:00	$560	$549	$3,258	Less than base	More than base
8/29/2022	8/30/2022 7:00	$2,344	$2,628	$970	More than base	Less than base
8/29/2022	8/30/2022 10:00	$6	$3,128	$973	More than base	More than base
9/5/2022	9/5/2022 7:00	$1,388	$8	$274	Less than base	Less than base
9/5/2022	9/5/2022 8:00	$8	$1,812	$2,819	More than base	More than base
9/5/2022	9/5/2022 8:00	$8	$1,812	$2,819	More than base	More than base
9/12/2022	9/15/2022 21:00	$1,300	$1,804	$1,292	More than base	Less than base
9/12/2022	9/16/2022 7:00	$537	$2,422	$1,678	More than base	More than base
9/12/2022	9/16/2022 8:00	$800	$1,735	$1,717	More than base	More than base
9/19/2022	9/19/2022 21:00	$965	$467	$1,248	Less than base	More than base
9/19/2022	9/23/2022 9:00	$279	$2,880	$1,027	More than base	More than base
9/19/2022	9/24/2022 7:00	$86	$554	$1,782	More than base	More than base
9/26/2022	9/26/2022 18:00	$1,037	$935	$1,726	Less than base	More than base
9/26/2022	9/29/2022 7:00	$1,456	$389	$849	Less than base	Less than base
9/26/2022	9/30/2022 7:00	$1,067	$1,355	$1,257	More than base	More than base
10/3/2022	10/6/2022 7:00	$710	$1,392	$1,501	More than base	More than base
10/3/2022	10/6/2022 7:00	$710	$1,392	$1,501	More than base	More than base
10/3/2022	10/6/2022 8:00	$700	$265	$1,783	Less than base	More than base
10/10/2022	10/12/2022 19:00	$540	$1,669	$984	More than base	More than base
10/10/2022	10/13/2022 10:00	$567	$634	$1,648	More than base	More than base
10/10/2022	10/13/2022 11:00	$608	$619	$1,337	More than base	More than base
10/17/2022	10/18/2022 18:00	$79	$827	$1,946	More than base	More than base
10/17/2022	10/21/2022 20:00	$228	$1,589	$1,335	More than base	More than base
10/17/2022	10/23/2022 14:00	$762	$32	$1,246	Less than base	More than base
10/24/2022	10/24/2022 5:00	$223	$1,281	$1,452	More than base	More than base
10/24/2022	10/24/2022 6:00	$233	$955	$1,662	More than base	More than base
10/24/2022	10/30/2022 19:00	$698	$559	$1,092	Less than base	More than base
10/31/2022	10/31/2022 11:00	$464	$2,025	$1,212	More than base	More than base
10/31/2022	11/1/2022 15:00	$627	$1,009	$1,598	More than base	More than base
10/31/2022	11/2/2022 9:00	$70	$603	$1,739	More than base	More than base
11/7/2022	11/9/2022 8:00	$668	$960	$464	More than base	Less than base
11/7/2022	11/9/2022 18:00	$440	$1,721	$1,290	More than base	More than base
11/7/2022	11/12/2022 13:00	$454	$741	$1,629	More than base	More than base
11/14/2022	11/14/2022 8:00	$310	$1,521	$966	More than base	More than base
11/14/2022	11/17/2022 11:00	$262	$493	$1,993	More than base	More than base
11/14/2022	11/18/2022 11:00	$619	$561	$1,258	Less than base	More than base
11/21/2022	11/22/2022 8:00	$654	$702	$1,654	More than base	More than base
11/21/2022	11/23/2022 15:00	$37	$1,218	$1,303	More than base	More than base
11/21/2022	11/26/2022 9:00	$731	$650	$1,189	Less than base	More than base
11/28/2022	11/28/2022 18:00	$1,561	$2,302	$2,705	More than base	More than base
11/28/2022	11/28/2022 19:00	$1,730	$1,483	$2,355	Less than base	More than base
11/28/2022	12/4/2022 21:00	$450	$1,491	$3,018	More than base	More than base
12/5/2022	12/5/2022 8:00	$3,630	$1,991	$4,061	Less than base	More than base
12/5/2022	12/5/2022 8:00	$3,630	$1,991	$4,061	Less than base	More than base
12/5/2022	12/5/2022 9:00	$3,991	$1,410	$2,715	Less than base	Less than base
12/12/2022	12/13/2022 23:00	$737	$919	$524	More than base	Less than base
12/12/2022	12/13/2022 23:00	$737	$919	$524	More than base	Less than base
12/12/2022	12/18/2022 18:00	$355	$515	$2,193	More than base	More than base
12/19/2022	12/23/2022 18:00	$1,662	$2,067	$3,718	More than base	More than base
12/19/2022	12/23/2022 18:00	$1,662	$2,067	$3,718	More than base	More than base
12/19/2022	12/23/2022 18:00	$1,662	$2,067	$3,718	More than base	More than base
12/26/2022	12/26/2022 9:00	$508	$1,715	$862	More than base	More than base
12/26/2022	12/29/2022 22:00	$1,176	$966	$3,383	Less than base	More than base
12/26/2022	12/30/2022 19:00	$2,127	$816	$2,668	Less than base	More than base
8/29/2022	8/29/2022 12:00	$560	$549	$3,258	Less than base	More than base
8/29/2022	8/30/2022 7:00	$2,344	$2,628	$970	More than base	Less than base
8/29/2022	8/30/2022 10:00	$6	$3,128	$973	More than base	More than base
9/5/2022	9/5/2022 7:00	$1,388	$8	$274	Less than base	Less than base
9/5/2022	9/5/2022 8:00	$8	$1,812	$2,819	More than base	More than base
9/5/2022	9/5/2022 8:00	$8	$1,812	$2,819	More than base	More than base
9/12/2022	9/15/2022 21:00	$1,300	$1,804	$1,292	More than base	Less than base

LMP Impact of Planned and Forced Outages

Percent of time with any congestion present in LRZ1 footprint.

System Intact	CROW	CROW+Forced
91%	93%	97%

Average LMP for LRZ1 areas.

Area	Avg LMP System Intact	Avg LMP CROW	Avg LMP CROW+Forced
DPC	$31.35	$32.13	$35.15
GRE	$26.55	$27.79	$27.30
MDU	$24.15	$35.04	$33.82
MP	$30.43	$27.28	$27.58
NSP	$27.63	$29.75	$30.52
OTP	$26.29	$25.72	$23.00
SMP	$26.48	$27.94	$29.17

Observations

- Congestion is typically highest in times with high wind around the morning or evening peak load.
- The system intact operating state (i.e., without planned or unplanned outages) has baseline congestion.
- The operating state with CROW outages increases congestion moderately.
- The operating state with CROW and a selected set of forced outages also increases congestion moderately.
- Patterns in all of the operating states show congestion between:
    - Wind generation areas in southwest Minnesota and the Twin Cities metro
    - Minnesota and Wisconsin
    - Twin Cities and northern Minnesota
    - Dakotas/far western Minnesota and the rest of Minnesota

Congestion Study Addendum 1: Planned outages modeled from CROW

Planned Outage Branch	Start	End
14L TAP7_608731 to NATIONL7_608733 1	10/6/2022 8:00	10/6/2022 16:00
16L TAP7_608718 to ETCO_7_608721 1	10/8/2022 12:00	10/8/2022 16:00
44L TAP7_608725 to HIBBTAC7_608728 1	9/12/2022 8:00	9/14/2022 10:00
44L TAP7_608725 to HIBBTAC7_608728 1	9/27/2022 8:00	9/27/2022 16:00
44L TAP7_608725 to HIBBTAC7_608728 1	9/28/2022 8:00	9/28/2022 16:00
78L TAP7_608730 to NATIONL7_608733 1	9/27/2022 8:00	9/27/2022 16:00
78L TAP7_608730 to NATIONL7_608733 1	9/28/2022 8:00	9/28/2022 16:00
78L TAP7_608730 to NATIONL7_608733 1	10/6/2022 8:00	10/6/2022 16:00
78L TAP7_608730 to NATIONL7_608733 1	10/17/2022 8:00	10/18/2022 16:00
88TH ST 5_635604 to ASHAWA5_635610 1	11/28/2022 9:00	12/9/2022 17:00
96TH ST_699364 to OCONNR-6_699400 1	10/10/2022 8:00	10/14/2022 16:00
96TH ST_699364 to PARKHILL_699421 1	9/13/2022 8:00	9/15/2022 16:00
ABBOTT 5_631000 to TRAER 5_631083 1	10/24/2022 9:00	10/27/2022 15:00
ACEC BADGERW_698840 to SAR 138_699240 1	9/1/2022 0:00	10/14/2022 17:00
AMBERG5_699524 to STILES3_699585 1	9/12/2022 6:00	9/23/2022 16:00
AMBERG5_699524 to STILES3_699585 1	11/7/2022 7:00	11/11/2022 17:00
ARBOR HILL 3_635580 to RCCN TRL 3_635622 1	11/28/2022 9:00	12/10/2022 17:00
ARCADIAN 345_699247 to PLS PR1_699432 1	10/10/2022 8:00	10/14/2022 16:00
ARCADIAN 345_699247 to PLS PR1_699432 1	11/1/2022 8:00	11/16/2022 17:00
ARNOLD1G_629074 to ARNOLD 5_631088 1	9/25/2020 7:00	12/31/2022 23:00
ARROWHD4_608615 to YBUS2416_97582 2	9/19/2022 8:00	9/30/2022 23:00
AS KING3_601014 to CHIS CO3_601018 1	11/1/2022 7:00	11/15/2022 18:00
AS KING7_603058 to WILOWRV7_603155 1	9/19/2022 8:00	9/23/2022 19:00
AUDUBON4_620336 to YBUS2512_97486 1	10/4/2022 9:00	10/4/2022 10:00
BAYTOWN7_603048 to LONG LK7_603086 1	10/17/2022 7:00	11/29/2022 19:00
BISON 3_601067 to BUFFALO3_620358 1	10/31/2022 8:00	12/2/2022 19:00
BLK DG27_603066 to GRE-GLNDALE7_615541 1	12/1/2022 8:00	12/1/2022 19:00
BLK DG27_603066 to GRE-PILOTKB7_615446 1	12/1/2022 8:00	12/1/2022 19:00
BLUE LK3_601015 to PARKERS3_601022 1	10/10/2022 7:00	10/14/2022 18:00
BLUE LK3_601015 to SCOTTCO3_601055 1	10/24/2022 7:00	10/28/2022 18:00
BLUE LK7_603062 to HYLNDLK7_603080 1	9/26/2022 7:00	10/14/2022 18:00
BLUE LK7_603062 to HYLNDLK7_603080 1	10/24/2022 7:00	10/28/2022 18:00
BONDURANT3_635680 to MONTEZUMA 3_635730 1	11/7/2022 9:00	11/12/2022 18:00
BONDURANT3_635680 to MONTEZUMA 3_635730 1	12/19/2022 9:00	12/27/2022 18:00
BONDURANT3_635680 to SYCAMORE 3_635700 1	11/21/2022 9:00	11/25/2022 18:00
BONDURANT3_635680 to SYCAMORE 3_635700 1	12/5/2022 9:00	12/17/2022 18:00
BOSWELL7_608748 to BLKWATER7_608786 1	10/4/2022 8:00	10/4/2022 16:00
BRAINRD7_608652 to GRE-NOKAY_7_616702 1	9/27/2022 10:00	9/27/2022 11:00
B-RIDGE_699460 to RUBICON_699477 1	10/17/2022 9:00	10/21/2022 9:00
BRIGGS RD 5_601043 to LAC TAP5_681531 1	10/24/2022 8:00	10/28/2022 16:00
BRIGGS RD 5_601043 to MAYFAIR5_602026 1	9/6/2022 8:00	3/3/2023 17:00
BROOKDALE B2_699284 to KANSAS-6_699344 1	9/19/2022 9:00	9/19/2022 16:00
BRUCE TP_620208 to TORONTO7_620210 1	9/21/2022 8:00	9/21/2022 14:00
BSSOUTH3_620417 to YBUS2523_97475 1	9/20/2022 7:00	9/20/2022 18:00
BSSOUTH3_620417 to YBUS2524_97474 2	9/21/2022 7:00	9/21/2022 18:00
BSSOUTH4_620322 to YBUS2523_97475 1	9/20/2022 7:00	9/20/2022 18:00
BSSOUTH4_620322 to YBUS2524_97474 2	9/21/2022 7:00	9/21/2022 18:00
BUFFALO3_620358 to YBUS2515_97483 2	8/1/2022 8:00	8/1/2023 17:00
BUFFALO7_620258 to YBUS2515_97483 2	8/1/2022 8:00	8/1/2023 17:00
BUFFRID7_603134 to YANKEE 7_603191 1	10/17/2022 7:00	11/18/2022 18:00
BURR_7_620212 to MARIETT7_620213 1	5/16/2022 9:00	12/6/2022 0:00
BUTTRNT4_699270 to FORWD EC_699868 1	9/12/2022 6:00	9/15/2022 16:00
BVR CRK5_681527 to HARMONY5_681528 1	9/20/2022 6:00	9/20/2022 11:00
CATAWBA7_603147 to PRENTCE7_603148 1	11/18/2022 11:00	11/18/2022 17:00
CBLUFFS3_635000 to OVERLAND 3_635014 1	11/28/2022 9:00	11/30/2022 16:00
CBLUFFS3_635000 to PONY CRK 3_635013 1	11/21/2022 9:00	11/23/2022 16:00
CBLUFFS3_635000 to SOUTHLAND 3_635016 1	10/19/2022 8:00	10/21/2022 15:00
CBLUFFS3_635000 to SOUTHLAND 3_635016 1	11/16/2022 9:00	11/18/2022 16:00
CBLUFFS3_635000 to YBUS2536_97462 1	9/15/2022 8:00	10/26/2022 15:00
CBLUFFS3_635000 to YBUS2537_97461 2	10/31/2022 8:00	12/2/2022 16:00
CBLUFFS5_635001 to YBUS2536_97462 1	9/15/2022 8:00	10/26/2022 15:00
CBLUFFS5_635001 to YBUS2537_97461 2	10/31/2022 8:00	12/2/2022 16:00
CDRVALE7_603064 to BLK DG27_603066 1	11/28/2022 9:00	12/16/2022 17:00
CHART IN_699177 to HOLLND_699288 1	10/20/2022 6:00	10/20/2022 15:00
CHART IN_699177 to SAUKVL2_699271 1	10/20/2022 6:00	10/20/2022 15:00
CHEMOLT7_603067 to LINDETP7_603106 1	9/12/2022 7:00	9/16/2022 17:00
CHIS CO3_601018 to KOLMNLK3_601021 1	11/1/2022 7:00	11/15/2022 18:00
CLEARCREKJ18_630808 to JOHNSON8_630809 1	9/4/2021 8:00	10/31/2022 23:00
COLVILL 5_602000 to YBUS2379_97619 5	7/12/2022 8:00	12/1/2022 19:00
COLVILL 5_602000 to YBUS2379_97619 5	7/12/2022 12:00	12/1/2022 23:00
CONCRD 4_699283 to CRWFSH R_699375 1	10/18/2022 6:00	10/28/2022 16:00
COTTAGE7_603069 to REDROCK7_603097 1	10/3/2022 7:00	10/11/2022 18:00
CRANBRY 2_698657 to THREE LK_699779 1	9/12/2022 6:00	9/16/2022 16:00
CRYSTAL5_602035 to EAST BALDWN5_602045 1	9/13/2022 8:00	9/13/2022 14:00
CRYSTAL5_602035 to EAST BALDWN5_602045 1	9/26/2022 7:00	9/30/2022 16:00
DEANLAK7_603119 to GRE-ZINRAN 7_618704 1	10/24/2022 7:00	10/28/2022 18:00

Planned Outage Branch	Start	End
DEVILSE7_620265 to RAMSEY 7_620266 1	9/26/2022 9:00	10/20/2022 15:00
DRAYTON4_657752 to LETELER4_667048 1	9/19/2022 13:00	9/19/2022 16:00
DRAYTON4_657752 to LETELER4_667048 1	9/19/2022 13:00	9/19/2022 16:00
DRAYTON4_657752 to PRAIRIE4_657755 1	9/19/2022 13:00	9/19/2022 16:00
DRAYTON4_657752 to YBUS2913_97085 1	9/14/2022 10:00	10/21/2022 18:00
DRAYTON4_657752 to YBUS2914_97084 2	8/15/2022 7:00	9/14/2022 10:00
DRAYTON7_657705 to YBUS2913_97085 1	9/14/2022 10:00	10/21/2022 18:00
DRAYTON7_657705 to YBUS2914_97084 2	8/15/2022 7:00	9/14/2022 10:00
E CALMS5_631095 to GR MND 5_631096 1	11/7/2022 8:00	11/23/2022 17:00
E CALMS5_631095 to SUB 56 5_636616 1	11/14/2022 9:00	11/23/2022 17:00
EAGLEPT7_603137 to PINE LK7_603151 1	10/7/2022 8:00	10/7/2022 16:00
EAU CL 3_601028 to ARPIN B4_694003 1	11/28/2022 9:00	2/28/2023 17:00
EDEN PR3_601025 to YBUS2364_97634 9	7/12/2022 12:00	12/1/2022 23:00
EDINA 7_603073 to NINE MI7_603135 1	10/3/2022 7:00	10/3/2022 18:00
EDINA 7_603073 to STLSPRK7_603108 1	11/21/2022 9:00	12/5/2022 17:00
EDINA 7_603073 to VIKING7_603246 1	10/3/2022 7:00	10/3/2022 18:00
ELBOWLK7_658104 to BRANDN 7_658106 1	10/17/2022 7:00	11/4/2022 15:00
ELLENDL345 3_661097 to YBUS2990_97008 1	12/5/2022 10:00	12/16/2022 17:00
ELLOTPK7_603074 to MAIN ST7_603088 1	9/26/2022 7:00	10/14/2022 18:00
ELM CRK3_601005 to MNTCELO3_601010 1	8/1/2022 7:00	9/30/2022 18:00
ELM CRK3_601005 to PARKERS3_601022 1	11/30/2022 9:00	1/26/2023 17:00
ETCO 7_608721 to FORBES 7_608722 1	9/19/2022 8:00	9/28/2022 16:00
ETCO 7_608721 to FORBES 7_608722 1	10/8/2022 12:00	10/8/2022 16:00
FINLND_7_608694 to N_SHORE7_608915 1	9/22/2022 8:00	9/22/2022 16:00
FINLND_7_608694 to N_SHORE7_608915 1	9/29/2022 7:00	10/10/2022 18:00
FORBES 2_601001 to CHIS-N 2_601017 1	9/15/2022 8:00	9/16/2022 23:00
FORBES 2_601001 to ROSEAUS2_601013 1	9/15/2022 6:00	9/16/2022 18:00
FORBES 4_608624 to YBUS2334_97664 2	9/19/2022 8:00	9/28/2022 16:00
FORBES 4_608624 to YBUS2422_97576 3	9/6/2022 8:00	9/17/2022 16:00
FORBES 4_608624 to YBUS2422_97576 3	10/6/2022 8:00	10/13/2022 16:00
FORBES 7_608722 to 44L TAP7_608725 1	6/16/2022 9:00	12/1/2022 23:00
FORBES 7_608722 to 44L TAP7_608725 1	9/6/2022 8:00	9/17/2022 16:00
FORBES 7_608722 to 44L TAP7_608725 1	9/27/2022 8:00	9/27/2022 16:00
FORBES 7_608722 to 44L TAP7_608725 1	9/28/2022 8:00	9/28/2022 16:00
FORBES 7_608722 to 78L TAP7_608730 1	9/6/2022 8:00	9/17/2022 16:00
FORBES 7_608722 to 78L TAP7_608730 1	9/27/2022 8:00	9/27/2022 16:00
FORBES 7_608722 to 78L TAP7_608730 1	9/28/2022 8:00	9/28/2022 16:00
FORBES 7_608722 to 78L TAP7_608730 1	10/17/2022 8:00	10/18/2022 16:00
FORBES 7_608722 to IRON TP7_608734 1	9/6/2022 8:00	9/17/2022 16:00
FORBES 7_608722 to IRON TP7_608734 1	9/27/2022 8:00	9/27/2022 16:00
FORBES 7_608722 to IRON TP7_608734 1	9/28/2022 8:00	9/28/2022 16:00
FOXRIVER B1_694022 to N APPLETON_699359 1	11/7/2022 7:00	11/7/2022 17:00
GALENA8_680441 to COMMERCE8_680578 1	10/4/2022 12:00	10/4/2022 16:00
GALENA8_680441 to WSTGALTP_680464 1	10/4/2022 12:00	10/4/2022 16:00
GARFIELD 7_603277 to ENTERPRISPK7_603278 1	9/12/2022 8:00	9/15/2022 8:00
GENOA 5_681523 to HARMONY5_681528 1	9/19/2022 5:00	9/19/2022 11:00
GLENDALE_699309 to CUSTER TERM_699486 1	9/13/2022 6:00	9/13/2022 16:00
GLENDALE_699309 to CUSTER TERM_699486 2	9/13/2022 6:00	9/13/2022 16:00
GLENHAM4_661038 to YBUS2983_97015 1	9/28/2022 22:00	9/29/2022 5:00
GLENHAM4_661038 to YBUS2984_97014 2	9/27/2022 22:00	9/28/2022 22:00
GRANGRAE_681525 to NED 161_699010 1	8/3/2022 6:00	9/29/2022 15:00
GRANGRAE_681525 to NED 161_699010 1	9/26/2022 9:00	10/7/2022 16:00
GRANITF4_652550 to WMU-WILLMAR4_658259 1	10/3/2022 8:00	10/28/2022 16:00
GRANTCO7_658102 to ELBOWLK7_658104 1	10/17/2022 7:00	11/4/2022 15:00
GRANVILLE B2_694124 to ARCADIAN 345_699247 1	10/24/2022 9:00	10/24/2022 11:00
GRE-BENSON 8_615366 to GRE-SWIFTFL8_616061 1	10/4/2022 11:00	10/6/2022 14:00
GRE-COAL CR4_615600 to GRE-COAL TP4_615900 1	9/12/2022 7:00	9/15/2022 15:00
GRE-COAL CR4_615600 to GRE-STANTON4_615901 1	9/12/2022 7:00	9/15/2022 15:00
GRE-COAL TP4_615900 to GRE-STANTON4_615901 1	10/24/2022 7:00	10/28/2022 15:00
GRE-CROWRIV7_615590 to YBUS2488_97510 1	9/14/2022 8:00	9/15/2022 16:00
GRE-FISHTTP7_616715 to GRE-MOTLEY 7_616716 1	9/1/2022 0:00	10/14/2022 23:00
GRE-INMAN 4_615300 to YBUS2436_97562 1	9/12/2022 9:00	9/13/2022 15:00
GRE-MCHENRY4_615347 to YBUS2448_97550 1	10/24/2022 8:00	10/27/2022 14:00
GRE-MCHENRY7_615348 to YBUS2448_97550 1	10/24/2022 8:00	10/27/2022 14:00
GRE-SPRGCK15_615477 to YBUS2470_97528 1	9/26/2022 7:00	9/29/2022 16:00
GRE-STANTON4_615901 to SQBUTTE4_657756 1	9/21/2022 7:00	9/21/2022 14:00
GRE-STANTON4_615901 to SQBUTTE4_657756 1	11/7/2022 8:00	11/17/2022 17:00
GRE-VIRGNIA8_615500 to GRE-PIKE RV8_618072 1	9/26/2022 8:00	9/29/2022 18:00
GRE-VIRGNIA8_615500 to YBUS2474_97524 1	9/26/2022 8:00	9/29/2022 18:00
GRE-WILLMAR7_619976 to WMU-PRIAM 7_658258 1	8/31/2022 8:00	10/28/2022 16:00
GRIMES 3_635600 to RCCN TRL 3_635622 1	11/7/2022 9:00	11/12/2022 17:00
GRIMES 3_635600 to RCCN TRL 3_635622 2	11/7/2022 9:00	11/12/2022 17:00
HARRISON_138_699792 to YBUS3030_96968 1	9/17/2022 7:00	9/18/2022 16:00
HARVEY 4_620290 to UNDERWD4_620381 1	10/25/2022 9:00	10/25/2022 14:00
HATTRCK7_608747 to 37L TAP7_608917 1	9/27/2022 8:00	9/27/2022 16:00
HATTRCK7_608747 to 37L TAP7_608917 1	9/28/2022 8:00	9/28/2022 16:00
HAWKIN 7_603146 to CATAWBA7_603147 1	11/18/2022 11:00	11/18/2022 17:00
HAWKIN 7_603146 to CATAWBA7_603147 1	11/28/2022 9:00	12/24/2022 0:00
HAZEL CK3_601054 to YBUS2375_97623 9	12/12/2022 8:00	12/12/2022 19:00
HAZLTON3_631139 to ARNOLD 3_631142 1	9/14/2022 7:00	9/16/2022 16:00
HAZLTON3_631139 to ARNOLD 3_631142 1	10/3/2022 7:00	10/4/2022 16:00

Planned Outage Branch	Start	End
HAZLTON3_631139 to BLACKHAWK 3_636199 1	10/5/2022 8:00	10/7/2022 14:00
HERB LK4_667054 to RALL 4_667059 1	9/22/2022 8:00	9/22/2022 16:00
HIBBING7_608724 to 44L TAP7_608725 1	9/12/2022 8:00	9/14/2022 10:00
HIBBING7_608724 to 44L TAP7_608725 1	9/27/2022 8:00	9/27/2022 16:00
HIBBING7_608724 to 44L TAP7_608725 1	9/28/2022 8:00	9/28/2022 16:00
HIBBING7_608724 to 44L TAP7_608725 1	10/7/2022 8:00	10/7/2022 16:00
HIBRDGE7_603079 to MERIMPK7_603090 1	9/26/2022 7:00	9/30/2022 18:00
HIWAY 22 B3_694030 to GARDR PK_699676 1	9/20/2022 8:00	9/20/2022 8:00
HOOT LK7_620223 to EDGETAP7_620233 1	10/10/2022 8:00	10/21/2022 17:00
HOOT LK7_620223 to FERGSFL7_658110 1	10/10/2022 8:00	10/21/2022 17:00
HOWRD GR_699223 to FOREST J_699533 1	10/17/2022 8:00	10/17/2022 12:00
HYLNDLK7_603080 to GRE-ZINRAN 7_618704 1	10/24/2022 7:00	10/28/2022 18:00
INLAND 7_608709 to MINNTAC7_608710 1	10/5/2022 8:00	10/5/2022 16:00
INLAND 7_608709 to MINNTAC7_608710 1	10/8/2022 8:00	10/8/2022 12:00
INVRGRV7_603083 to GRE-LEBNHLS7_616937 1	9/30/2022 8:00	10/1/2022 16:00
JACKSON5_602022 to TREMVAL5_602029 1	10/24/2022 8:00	11/11/2022 17:00
JACKSON5_602022 to TREMVAL5_602029 1	11/12/2022 9:00	11/28/2022 17:00
JAMESTN3_620369 to CENTER 3_657791 1	9/12/2022 8:00	9/16/2022 18:00
JAMESTN3_620369 to CENTER 3_657791 1	9/19/2022 8:00	9/23/2022 18:00
JAMESTN3_620369 to CENTER 3_657791 1	9/26/2022 8:00	9/30/2022 18:00
JAMESTN3_620369 to CENTER 3_657791 1	10/3/2022 8:00	10/7/2022 18:00
JAMESTN3_620369 to CENTER 3_657791 1	10/10/2022 8:00	10/14/2022 18:00
JAMESTN3_620369 to CENTER 3_657791 1	10/17/2022 8:00	10/21/2022 18:00
JAMESTN3_620369 to CENTER 3_657791 1	10/24/2022 8:00	10/28/2022 18:00
JOHNSON3_631208 to HILLS 3_636400 1	10/3/2022 7:00	10/7/2022 16:00
KARLSTA7_620149 to YBUS2499_97499 1	10/18/2022 8:00	10/18/2022 15:00
KARLSTA7_620149 to YBUS2499_97499 1	10/18/2022 8:00	10/18/2022 15:00
KEEWATINOHK4_667000 to HENDAY 4_667001 3	9/10/2022 7:00	9/12/2022 23:00
KOLMNLK3_601021 to YBUS2355_97643 9	7/12/2022 8:00	12/1/2022 19:00
KOLMNLK3_601021 to YBUS2355_97643 9	7/12/2022 12:00	12/1/2022 23:00
KOLMNLK3_601021 to YBUS2355_97643 9	9/15/2022 7:00	9/16/2022 15:00
LANSING L2 5_631052 to HARMONY5_681528 1	9/20/2022 11:00	9/20/2022 15:00
LBTY 138_699650 to 7THST_GB_699960 1	9/12/2022 9:00	9/12/2022 13:00
LETELER4_667048 to STANLEY4_667049 1	11/1/2022 8:00	11/15/2022 17:00
LITTL_MS-BE4_659265 to RHAME___-BE4_659266 1	10/10/2022 12:00	10/10/2022 15:00
LK NORDEN 7_620200 to HETLAND7_620209 1	9/15/2022 10:00	9/15/2022 11:00
LKFLDXL3_601029 to TRIMONT WD 3_601068 1	9/26/2022 8:00	9/28/2022 16:00
LONG LK7_603086 to OAKDALE7_603092 1	9/28/2022 7:00	10/17/2022 17:00
LOONLKTP_603122 to EASTWD18_603188 1	11/28/2022 8:00	1/10/2023 19:00
LYON CO 3_601048 to HAZEL CK3_601054 1	12/12/2022 8:00	12/12/2022 19:00
MAHNOMN7_620237 to ULRICH 7_657717 1	9/22/2022 8:00	9/23/2022 17:00
MAINE115_698800 to HILLTP_699703 1	9/12/2022 7:00	9/16/2022 16:00
MAINE115_698800 to HILLTP_699703 1	9/19/2022 6:00	9/22/2022 16:00
MAINE115_698800 to HILLTP_699703 1	9/26/2022 6:00	9/29/2022 16:00
MAINE115_698800 to HILLTP_699703 1	10/3/2022 6:00	10/6/2022 16:00
MAINE115_698800 to HILLTP_699703 1	10/10/2022 6:00	10/13/2022 16:00
MANDAN 4_661053 to NAPOLEON SW4_661091 1	8/15/2022 12:00	11/15/2022 17:00
MANDAN 7_661054 to MANDANW7_661067 1	9/22/2022 9:00	9/27/2022 16:00
MCARTHY4_608628 to CALUMET4_608629 1	9/19/2022 8:00	9/19/2022 16:00
MERIMPK7_603090 to PRIOR 7_603130 1	10/3/2022 7:00	10/7/2022 18:00
MESABA 7_608698 to FORBES 7_608722 1	9/19/2022 8:00	9/28/2022 16:00
MILACA 4_613140 to GRE-BENTON 4_615319 1	9/19/2022 9:00	9/21/2022 16:00
MILACA 4_613140 to YBUS2497_97501 1	9/19/2022 9:00	9/21/2022 16:00
MINEHAH7_603011 to LINCNCO7_603014 1	10/4/2022 7:00	10/5/2022 16:00
MINNTAC7_608710 to MNTCPTA7_608712 1	10/5/2022 8:00	10/5/2022 16:00
MINNTAC7_608710 to MNTCPTC7_608711 1	9/22/2022 7:00	9/22/2022 19:00
MINNTAC7_608710 to MNTCPTC7_608711 1	10/5/2022 8:00	10/5/2022 16:00
MINONG 5_608631 to GORDON 5_608918 1	9/13/2022 8:00	9/13/2022 16:00
MNTCELO3_601010 to SHERCO 3_601011 1	10/4/2022 7:00	10/4/2022 18:00
MNTCELO7_603031 to FIRST LK7_603272 1	9/19/2022 7:00	9/23/2022 18:00
MNTCELO7_603031 to GRE-OAKWOOD7_619806 1	9/19/2022 7:00	9/23/2022 18:00
MNTCELO7_603031 to GRE-OAKWOOD7_619806 1	9/26/2022 7:00	9/30/2022 18:00
MNTCELO7_603031 to GRE-OAKWOOD7_619806 1	10/17/2022 7:00	10/21/2022 18:00
MNTCELO7_603031 to GRE-OAKWOOD7_619806 1	12/7/2022 9:00	12/13/2022 17:00
MNTCELO7_603031 to SALIDA 7_603043 1	9/26/2022 7:00	9/30/2022 18:00
MNTCELO7_603031 to SALIDA 7_603043 1	10/17/2022 7:00	10/21/2022 18:00
MNTCELO7_603031 to SALIDA 7_603043 1	10/24/2022 7:00	10/28/2022 18:00
MNTCELO7_603031 to SALIDA 7_603043 1	11/11/2022 8:00	11/15/2022 19:00
MT VERN5_631073 to WYOMING5_631099 1	1/24/2022 8:00	10/14/2022 16:00
MUSCODA I PK_693835 to MUS 69_698119 1	5/27/2022 8:00	2/23/2025 23:00
NAMEWTP4_667057 to TOLKO 4_667058 1	9/17/2022 7:00	9/21/2022 19:00
NATIONL7_608733 to NASHWAK7_608737 1	10/6/2022 8:00	10/6/2022 16:00
NEAL S 5_635202 to NEAL N 5_635203 1	9/1/2020 0:00	12/15/2022 23:00
NEAL S 5_635202 to SALIX 5_635235 1	9/1/2020 0:00	12/15/2022 23:00
NED 138_699020 to LAN 138_699035 1	7/29/2022 6:00	9/23/2022 16:00
NED 138_699020 to LAN 138_699035 1	9/19/2022 7:00	9/30/2022 16:00
NED 138_699020 to LAN 138_699035 1	11/28/2022 8:00	12/17/2022 17:00
NELSON 8_605326 to GIL TAP8_605335 1	3/1/2022 0:00	11/19/2022 0:00
NELSON 8_605326 to GIL TAP8_605335 1	3/1/2022 0:00	11/19/2022 0:00
OAK GROVE5_636636 to SUB 18 5_636670 1	9/26/2022 8:00	9/28/2022 12:00
OAK GROVE5_636636 to SUB 18 5_636670 1	9/28/2022 12:00	9/30/2022 15:00

Planned Outage Branch	Start	End
OAK GROVE5_636636 to SUB 18 5_636670 2	9/19/2022 8:00	9/21/2022 12:00
OAK GROVE5_636636 to SUB 18 5_636670 2	9/28/2022 12:00	9/30/2022 15:00
OAKDALE7_603092 to TANRSLK7_603109 1	10/6/2022 8:00	10/6/2022 16:00
OAKDALE7_603092 to TANRSLK7_603109 1	10/7/2022 8:00	10/7/2022 16:00
OCONNR-6_699400 to 28THST-2_699494 1	10/10/2022 8:00	10/14/2022 16:00
OSPREY 7_603144 to HAWKIN 7_603146 1	9/16/2022 8:00	11/18/2022 11:00
OSPREY 7_603144 to HAWKIN 7_603146 1	11/18/2022 11:00	11/18/2022 17:00
OSSEO 7_603094 to WCNRAPD7_603112 1	11/16/2022 9:00	1/3/2023 17:00
OWATNNA5_613240 to S FARIB5_613380 1	4/12/2022 13:00	11/25/2022 17:00
PARIS WE_699410 to AR LQ T_699424 1	10/22/2022 8:00	10/28/2022 16:00
PARIS WE_699410 to RAYMOND_699982 1	10/22/2022 8:00	10/28/2022 16:00
PARKERS3_601022 to EDEN PR3_601025 1	10/10/2022 7:00	10/14/2022 18:00
PARKERS7_603095 to CEDARLK7_603173 1	9/28/2022 7:00	9/28/2022 17:00
PARKERS7_603095 to CEDARLK7_603173 1	9/29/2022 7:00	9/29/2022 17:00
PARKERS7_603095 to CEDARLK7_603173 1	10/27/2022 7:00	10/27/2022 17:00
PARKERS7_603095 to CEDARLK7_603173 1	10/28/2022 7:00	10/28/2022 17:00
PARKERS7_603095 to CEDARLK7_603173 1	10/31/2022 7:00	10/31/2022 17:00
PARKERS7_603095 to CEDARLK7_603173 1	11/1/2022 7:00	11/1/2022 17:00
PARKERS7_603095 to CEDARLK7_603173 1	11/2/2022 7:00	11/2/2022 17:00
PARKERS7_603095 to CEDARLK7_603173 1	11/3/2022 7:00	11/3/2022 17:00
PARKERS7_603095 to CEDARLK7_603173 1	11/4/2022 7:00	11/4/2022 17:00
PARKERS7_603095 to CEDARLK7_603173 1	11/7/2022 8:00	11/7/2022 18:00
PARKERS7_603095 to CEDARLK7_603173 1	11/8/2022 8:00	11/8/2022 18:00
PARKERS7_603095 to CEDARLK7_603173 1	11/9/2022 8:00	11/9/2022 18:00
PARKERS7_603095 to CEDARLK7_603173 1	11/10/2022 8:00	11/10/2022 18:00
PARKERS7_603095 to CEDARLK7_603173 1	11/11/2022 8:00	11/11/2022 18:00
PARKERS7_603095 to CEDARLK7_603173 1	11/12/2022 8:00	11/12/2022 18:00
PARKERS7_603095 to CEDARLK7_603173 1	11/13/2022 8:00	11/13/2022 18:00
PARKERS7_603095 to CEDARLK7_603173 1	11/14/2022 8:00	11/14/2022 18:00
PARKERS7_603095 to CEDARLK7_603173 1	11/15/2022 8:00	11/15/2022 18:00
PARKERS7_603095 to CEDARLK7_603173 1	11/16/2022 8:00	11/16/2022 18:00
PARKERS7_603095 to CEDARLK7_603173 1	11/17/2022 8:00	11/17/2022 18:00
PARKERS7_603095 to CEDARLK7_603173 1	11/18/2022 8:00	11/18/2022 18:00
PAYNES 4_602036 to WMU-WILLMAR4_658259 1	10/3/2022 8:00	10/28/2022 16:00
PEACE GARD 5_602057 to RUGBY 4_620379 1	9/21/2022 7:00	9/23/2022 18:00
PINE LK5_602027 to PINELKT5_602028 1	10/5/2022 8:00	10/6/2022 16:00
PINE LK5_602027 to YBUS2388_97610 3	10/5/2022 8:00	10/6/2022 16:00
PM4 138_699188 to HOWRD GR_699223 1	10/17/2022 8:00	10/17/2022 12:00
PR ISLD3_601003 to NROC 3_601039 1	10/3/2022 7:00	10/7/2022 18:00
PR ISLD3_601003 to REDROCK3_601023 1	10/31/2022 12:00	11/4/2022 12:00
PR ISLD3_601003 to REDROCK3_601023 2	10/10/2022 7:00	10/10/2022 17:00
QUARRY 3_601047 to YBUS2373_97625 9	7/12/2022 8:00	12/1/2022 19:00
QUARRY 3_601047 to YBUS2373_97625 9	7/12/2022 12:00	12/1/2022 23:00
RAMSEY 7_620266 to YBUS2446_97552 1	9/26/2022 9:00	10/20/2022 15:00
RANGELIN_699476 to CUSTER TERM_699486 1	9/13/2022 6:00	9/13/2022 16:00
RCCN TRL 3_635622 to BOONEVILLE 3_635630 1	11/28/2022 9:00	12/10/2022 17:00
REDROCK3_601023 to YBUS2358_97640 9	10/3/2022 7:00	10/11/2022 18:00
REDROCK3_601023 to YBUS2358_97640 9	10/10/2022 7:00	10/14/2022 18:00
REDROCK4_602015 to GRE-RUSH CY4_615460 1	11/1/2022 7:00	11/15/2022 18:00
ROCKY RN BV_694065 to GARDR PK_699676 1	9/12/2022 7:00	9/15/2022 16:00
ROSSER 4_667038 to YBUS2993_97005 2	10/5/2022 8:00	10/5/2022 16:00
ROSSER 4_667038 to YBUS2995_97003 4	9/12/2022 8:00	9/16/2022 16:00
SANDRDG J1 8_630297 to FRNTRSS LK 8_680580 1	9/12/2022 8:00	9/22/2022 16:00
SANDRDG J2 8_630763 to MENOMINE_680066 1	10/6/2022 6:00	10/6/2022 12:00
SAVANNA5_631066 to GALENA 5_681520 1	10/3/2022 8:00	10/3/2022 16:00
SENECA 5_681521 to GRANGRAE_681525 1	9/12/2022 7:00	9/12/2022 15:00
SENECA 5_681521 to GRANGRAE_681525 1	9/13/2022 7:00	9/13/2022 15:00
SENECA 5_681521 to GRANGRAE_681525 1	9/14/2022 7:00	9/14/2022 15:00
SENECA 5_681521 to GRANGRAE_681525 1	9/15/2022 7:00	9/15/2022 15:00
SENECA 5_681521 to GRANGRAE_681525 1	9/19/2022 7:00	9/19/2022 15:00
SENECA 5_681521 to GRANGRAE_681525 1	9/20/2022 7:00	9/20/2022 15:00
SENECA 5_681521 to GRANGRAE_681525 1	9/21/2022 7:00	9/21/2022 15:00
SENECA 5_681521 to GRANGRAE_681525 1	9/22/2022 7:00	9/22/2022 15:00
SENECA 5_681521 to GRANGRAE_681525 1	9/26/2022 7:00	9/26/2022 15:00
SENECA 5_681521 to GRANGRAE_681525 1	9/27/2022 7:00	9/27/2022 15:00
SENECA 5_681521 to GRANGRAE_681525 1	9/28/2022 7:00	9/28/2022 15:00
SENECA 5_681521 to GRANGRAE_681525 1	9/29/2022 7:00	9/29/2022 15:00
SFL 345 B1_694069 to COL 345_699157 1	7/11/2022 8:00	9/14/2022 16:00
SHANNON4_608627 to MCARTHY4_608628 1	9/19/2022 8:00	9/19/2022 16:00
SHANNON7_608749 to YBUS2426_97572 1	10/11/2022 8:00	10/12/2022 11:00
SHELDNP7_603143 to HOLCOMB7_603150 1	9/6/2022 7:00	9/12/2022 16:00
SHELDNP7_603143 to OSPREY 7_603144 1	9/15/2022 7:00	9/15/2022 16:00
SHERCO 3_601011 to COON CK3_601019 3	11/9/2022 8:00	12/22/2022 19:00
SHERCO 3_601011 to GRE-BUNKER 3_615327 2	10/5/2022 7:00	11/8/2022 19:00
SLVRBYH7_608691 to N_SHORE7_608915 1	9/22/2022 8:00	9/22/2022 16:00
SOURIS 7_603022 to MAGIC CITY 7_603270 1	9/15/2022 7:00	9/20/2022 18:00
SOURIS 7_603022 to MALLARD7_603023 1	9/7/2022 8:00	9/14/2022 18:00
SPCT_698620 to W.MARNET_699658 1	8/22/2022 7:00	9/16/2022 17:00
SPCT_698620 to W.MARNET_699658 1	10/10/2022 7:00	10/14/2022 13:00
SQBUTTE4_657756 to YBUS2929_97069 1	9/12/2022 8:00	9/16/2022 18:00
ST LAKE5_602017 to MINONG 5_608631 1	9/13/2022 7:00	9/13/2022 16:00

Planned Outage Branch	Start	End
ST LAKE5_602017 to PIP61 ST LK5_602053 1	10/12/2022 9:00	10/12/2022 15:00
STANLEY7_661080 to TIOGA4 7_661085 1	9/12/2022 10:00	9/12/2022 16:00
STANLEY7_661080 to TIOGA4 7_661085 1	10/10/2022 9:00	11/21/2022 17:00
STLSPRK7_603108 to ALDRICH B7_603206 1	8/22/2022 7:00	10/7/2022 18:00
STLSPRK7_603108 to CEDARLK7_603173 1	9/18/2022 8:00	9/18/2022 16:00
STLSPRK7_603108 to CEDARLK7_603173 1	9/28/2022 7:00	10/7/2022 18:00
STONE LK B1_694075 to YBUS3022_96976 9	10/13/2022 8:00	10/13/2022 14:00
SUB 39 3_636600 to MEC CORDOVA3_636605 1	11/14/2022 9:00	11/23/2022 17:00
THREE LK_699779 to VENUS_699780 1	9/19/2022 6:00	9/22/2022 16:00
THREE LK_699779 to VENUS_699780 1	12/12/2022 8:00	12/16/2022 18:00
TOLKO 4_667058 to RALL 4_667059 1	9/17/2022 7:00	9/21/2022 19:00
VIRDN W4_667066 to RESTON 4_667067 1	9/14/2022 8:00	9/14/2022 16:00
VIRGNIA7_608708 to 37L TAP7_608917 1	9/27/2022 8:00	9/27/2022 16:00
VIRGNIA7_608708 to 37L TAP7_608917 1	9/28/2022 8:00	9/28/2022 16:00
VIRGNIA7_608708 to INLAND 7_608709 1	10/8/2022 8:00	10/8/2022 12:00
W FARIB7_603001 to LOONLKTP_603122 1	11/28/2022 8:00	1/10/2023 19:00
WAHPETN4_620329 to FRONTER4_657750 1	9/19/2022 8:00	9/19/2022 17:00
WAHPETN7_620229 to YBUS2527_97471 2	9/29/2022 8:00	9/29/2022 17:00
WALLY RD_693889 to STG 69_698131 1	7/5/2022 7:00	9/25/2022 16:00
WARRVRS2_608412 to IRRN-RX2_608423 1	10/18/2022 7:00	10/20/2022 16:00
WATERLOO_693905 to BOX ELDR_698526 1	9/15/2022 5:00	9/15/2022 16:00
WDN 138_698093 to RC2 138_698094 1	9/12/2022 6:00	9/16/2022 16:00
WDN 138_698093 to RC2 138_698094 1	12/5/2022 8:00	12/16/2022 17:00
WILMART3_601004 to FIELD_N3_601033 1	10/10/2022 7:00	11/3/2022 18:00
WILMART3_601004 to YBUS2337_97661 9	11/7/2022 8:00	11/22/2022 19:00
WINGER 7_620238 to PLUMTAP7_620251 1	10/24/2022 8:00	10/24/2022 17:00
WISHEK 4_661094 to YBUS2989_97009 1	6/23/2022 9:00	11/11/2022 17:00
WMU-WILLMAR4_658259 to YBUS2936_97062 1	9/6/2022 10:00	10/28/2022 16:00
WODENSHO_699578 to MEARS CR_699675 1	9/26/2022 7:00	10/21/2022 16:00
WOODY 5_631110 to JEFF 5_631111 1	9/26/2022 7:00	9/30/2022 15:00