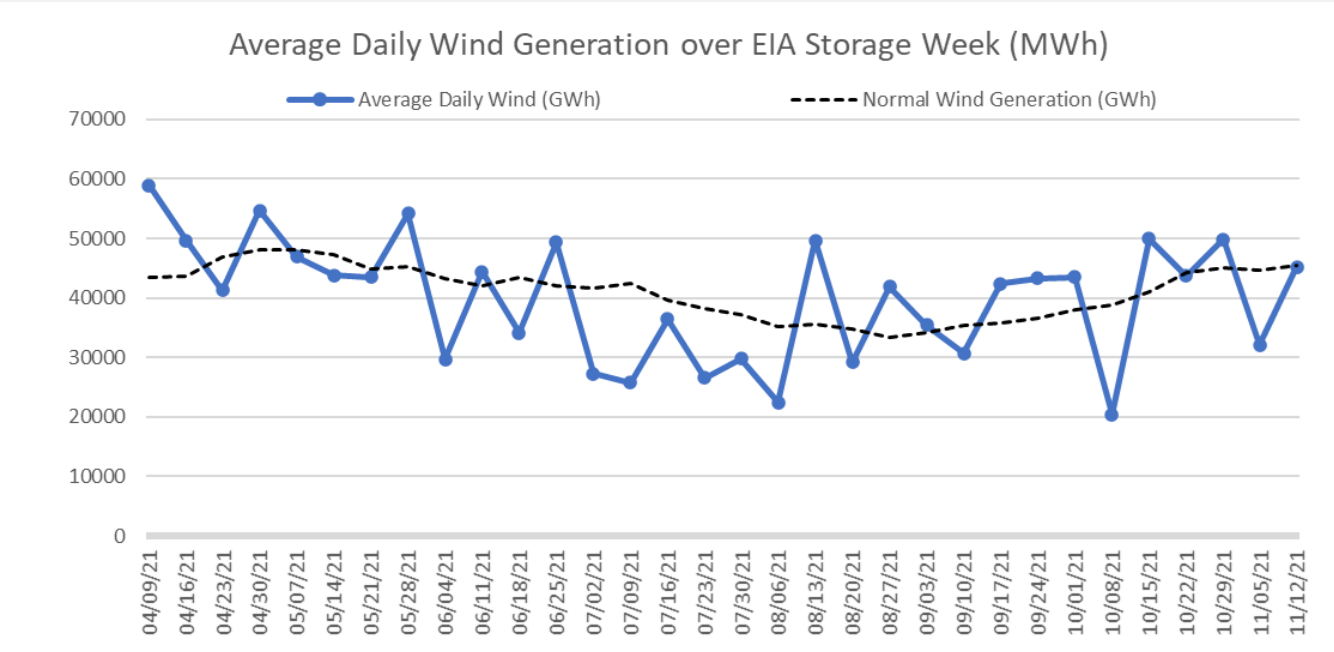
This past summer we consistently talked about the strong power burns and most week's we put the blame on lack of wind or low coal production/inventory. In this week's report, we took a deeper dive into the role the full renewable portfolio played – wind, solar, hydro, and nuke – in shifting the power stack and ultimately the level of gas burns each week.

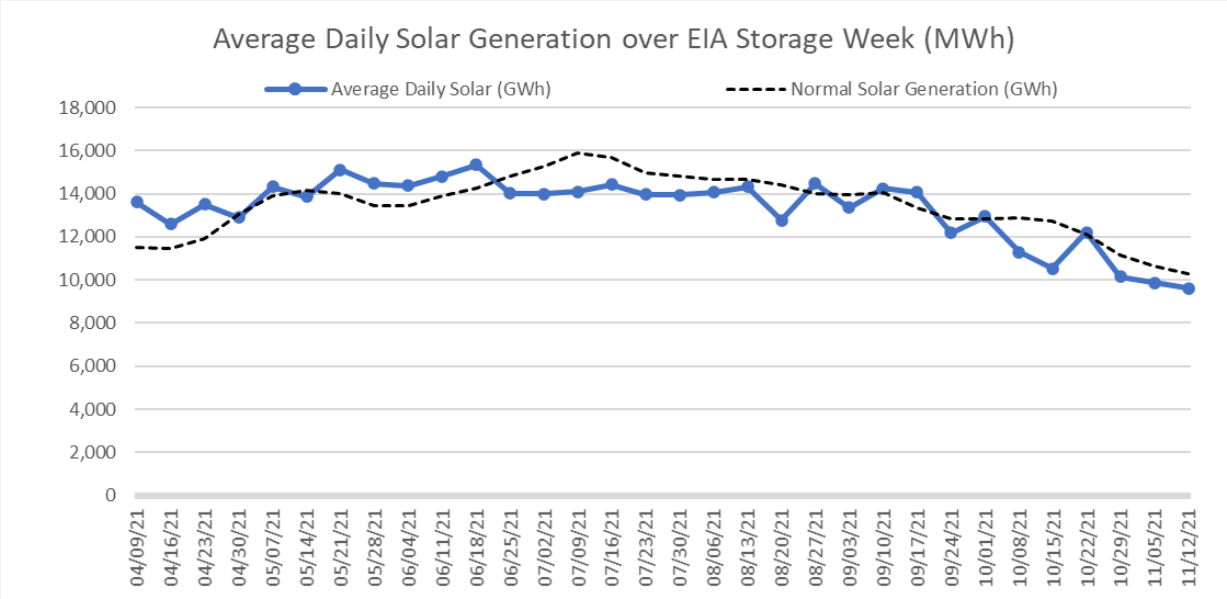
We developed the "expected" weekly generation from each renewable generation type by looking at the historical performance which takes into consideration maintenance schedules and seasonality. We should note that we did not take price into the because in general renewables are free and fall at the bottom of the dispatch stack.

First, let look at the individual performance of each renewable generation type through the summer. In calculating the "expected" wind level, we do make the necessary adjustments to account for the increasing or decreasing capacity of that generation type.

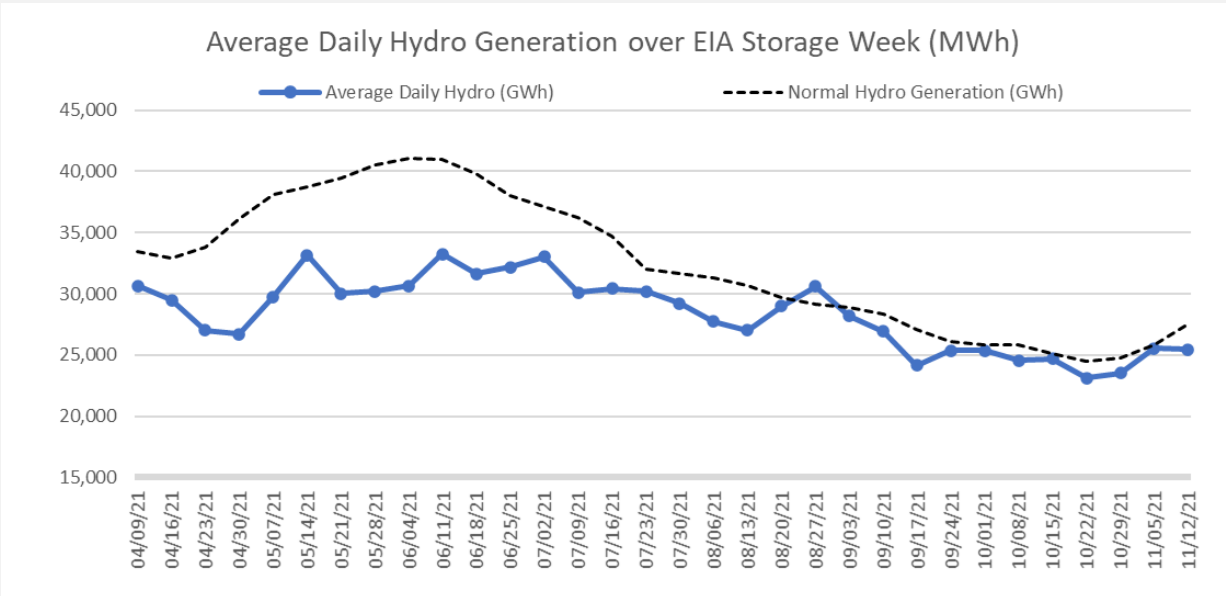
Wind: Wind generation is generally the weakest in the summer months. Overall wind generation's average performance was on par with the expected, i.e. 32% capacity factor during the summer vs the expected 33%. April had extremely strong wind, while the peak summer months had very low wind. So we got the strong wind when we did not need it, and the low wind when power demand was at its highest. As we observed this past summer, the weekly level of wind had a very strong impact on the storage injections.



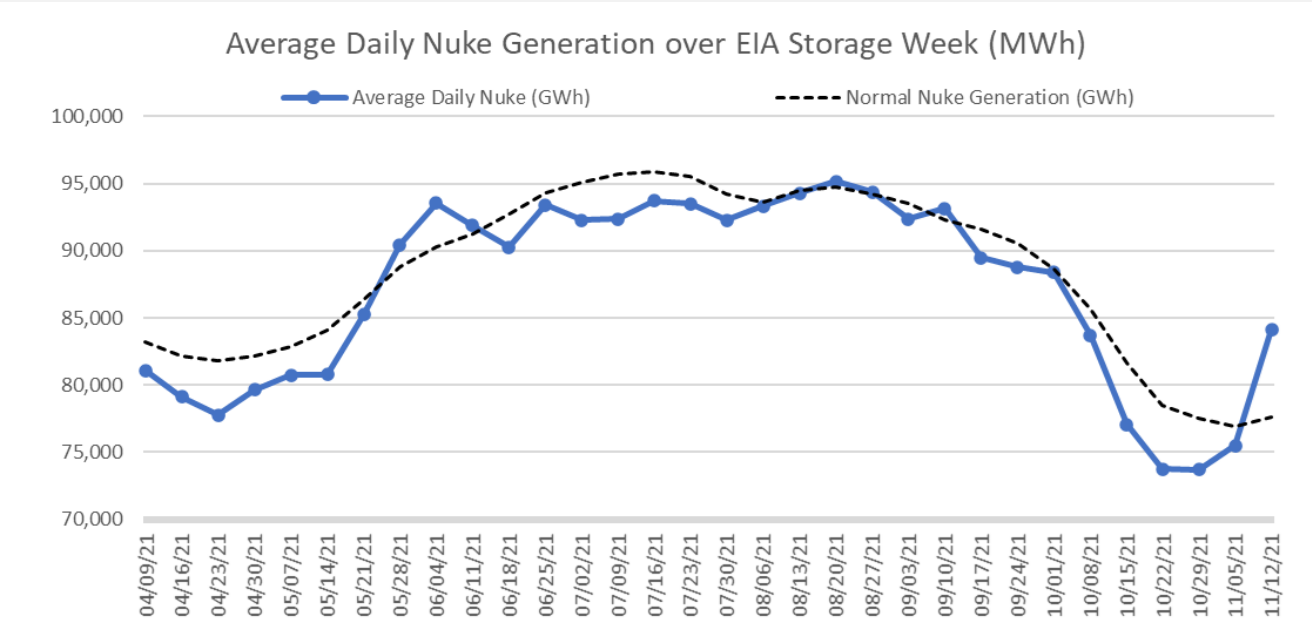
Solar: Solar generation is generally the strongest during the summer months which helps compliment the seasonality of wind. As with wind, overall solar generation's average performance was on par with the expected, i.e. 24.8% capacity factor during the summer vs the expected 25.1%. Solar either performed or underperformed for weeks in a row, which made it very different from the erratic nature of wind.



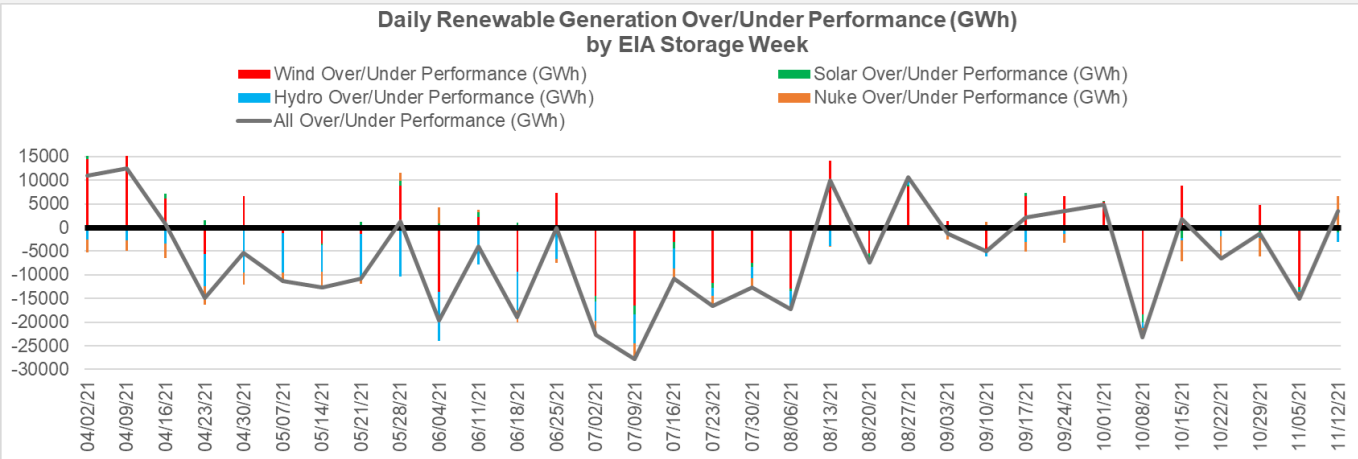
Hydro: Hydro looks to have the largest deviation away from expected levels. In the Q2 time frame, we saw very low levels of hydro power due to a combination of persistent unseasonably warm weather and low snowpack last winter. Overall hydro generation's average performance was 4% below the expected, i.e. a 28% capacity factor vs 32% over the summer.



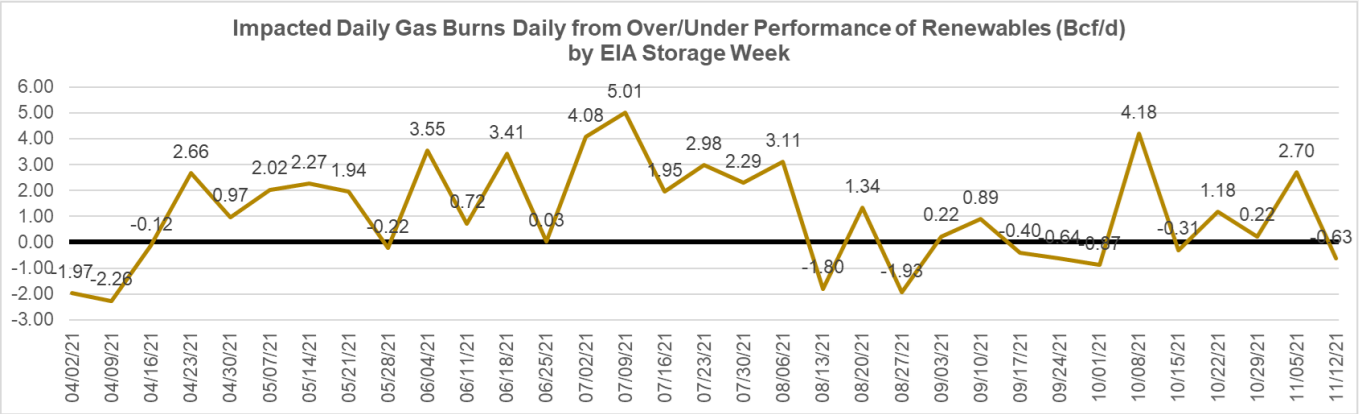
Nuke: Nuke performance lacked during the shoulder season relative to past years. This is generally the refueling/maintenance period where the fleet alternates going offline. We reckon that maintenance could have been a bit more extensive this year due to delays from the 2020 COVID year. Overall nuke generation's average performance was 1.6% below the expected, i.e. an 87.9% capacity factor vs 89.5% expected over the summer. The month of October saw some of the lower nuke generation levels in recent history.



Below is the aggregate over/under performance data to see how the net impact of all the renewable assets had on the natural gas generation fleet (at the national level).



As seen, most of the summer we had renewables lag their expected levels leading to strong natural gas burns. Next, we calculate the daily natural volume impact in Bcf by assuming that a 7.5 heat rate gas plant is either activated or displaced. As seen, gas burns were stronger 2/3 of the summer weeks due to weak renewable generation.



To focus on the last storage report, ie. the week ending Nov 5th, the lower renewables added 2.7 Bcf/d or 19 Bcf of extra power burns through the week. If we were to normalize the storage number for the over/under renewable performance we would have expected a +26 Bcf injection rather than the +7 Bcf that was reported.

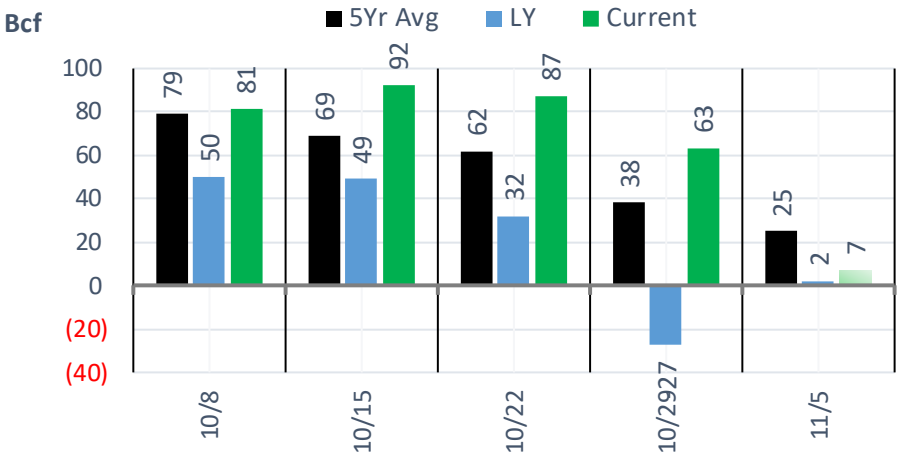
We went and did this every week over this summer to see what we would have injected if renewables would have performed at the expected levels. The total injections from the week ending April 9th to Nov 5th, we saw injections total 1,834 Bcf. If all the renewables did operate at expected levels, then we would have expected an additional +274 Bcf leading to a seasonal injection of 2,108 Bcf. Below is the breakdown by generation type.

Actual Summer21 Injection	Lower Wind	Lower Solar	Lower Hydro	Lower Nuke	NatGas	Summer21 Renewable Normalized Injection
	Under	Under	Under	Under	Resulting Extra Burns	
1,834	49	6	157	62	274	2,108

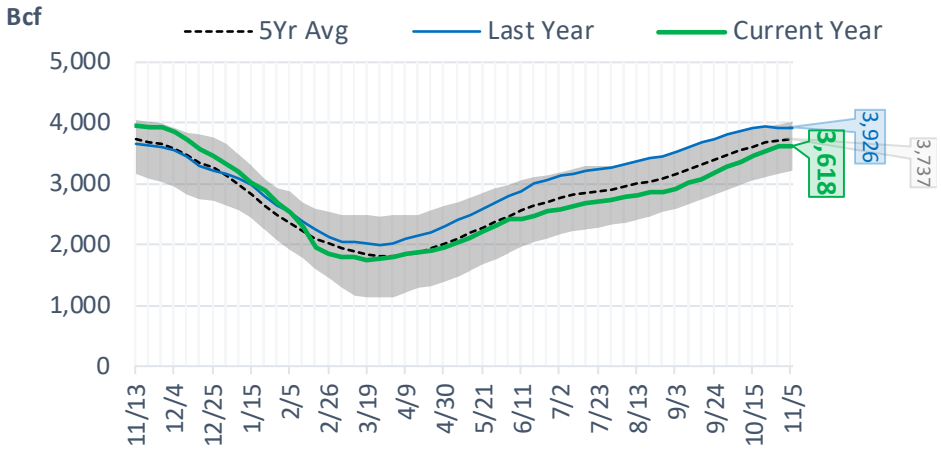
This is hypothetical, but it does give us a good idea of how influential renewables are becoming. With the added capacity, its impact will only grow.

EIA Storage Report

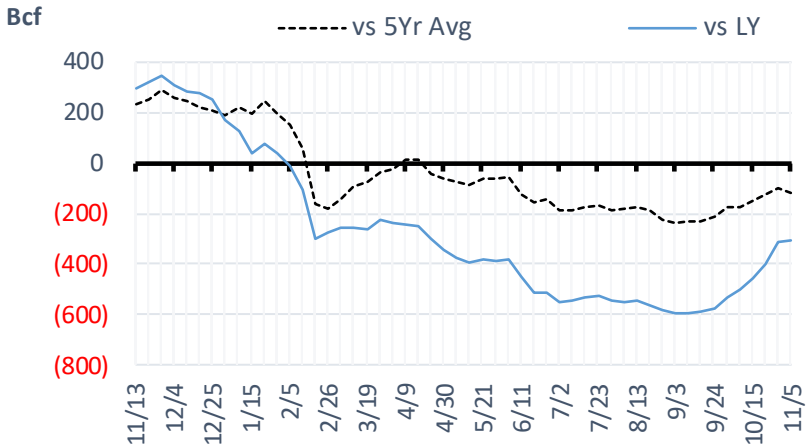
Total Lower 48 YoY Weekly Change



Total Lower 48 Storage Levels



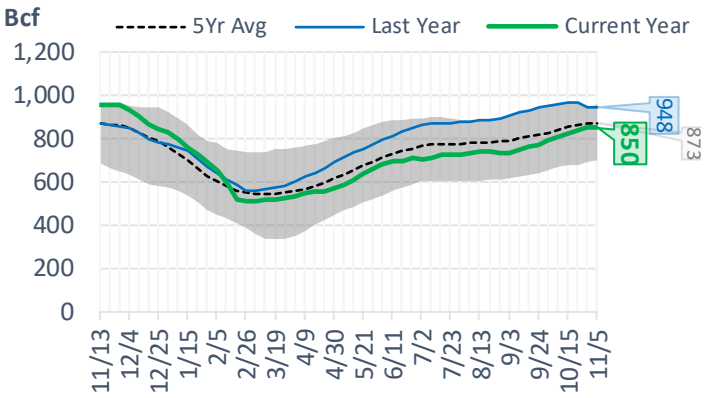
Total Lower 48 LY Surplus/Deficit



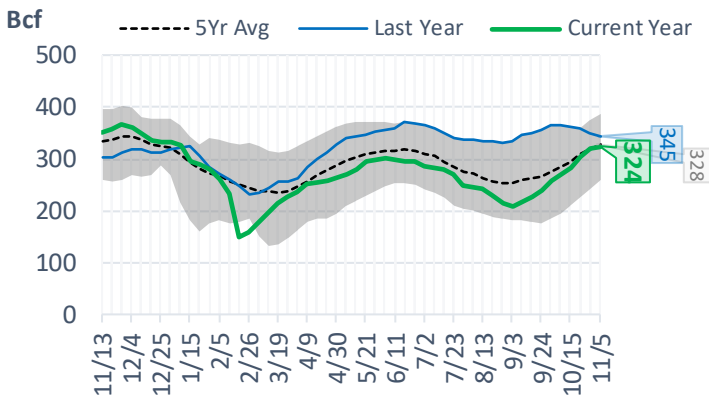
Natural Gas Storage Stats - Last 5 Weeks

Week Ending	Current 5-Nov	Week - 1 29-Oct	Week - 2 22-Oct	Week - 3 15-Oct	Week - 4 8-Oct	Week - 5 1-Oct
Total Lower 48 Storage Level	**3618**	3611	3548	3461	3369	3288
Weekly Change	**+7**	+63	+87	+92	+81	+118
vs LY	**-308**	-313	-403	-458	-501	-532
vs 5Yr Avg	**-119**	-101	-126	-151	-174	-176
S. Central Salt Storage Level	**324**	320	304	283	269	259
Weekly Change	**+4**	+16	+21	+14	+10	+20
vs LY	**-21**	-30	-56	-78	-97	-106
vs 5Yr Avg	**-4**	+1	-4	-10	-14	-15
S. Central NonSalt Storage Level	**850**	852	840	825	810	795
Weekly Change	**-2**	+12	+15	+15	+15	+21
vs LY	**-98**	-96	-128	-143	-149	-159
vs 5Yr Avg	**-23**	-17	-25	-30	-33	-35
Midwest Storage Level	**1075**	1071	1052	1027	997	971
Weekly Change	**+4**	+19	+25	+30	+26	+37
vs LY	**-51**	-48	-64	-75	-81	-87
vs 5Yr Avg	**-21**	-15	-18	-20	-23	-19
East Storage Level	**897**	899	885	862	834	810
Weekly Change	**-2**	+14	+23	+28	+24	+31
vs LY	**-46**	-47	-53	-59	-72	-80
vs 5Yr Avg	**-18**	-14	-21	-30	-42	-45
Mountain Storage Level	**213**	213	212	211	210	206
Weekly Change	**0**	+1	+1	+1	+4	+5
vs LY	**-30**	-28	-33	-33	-30	-29
vs 5Yr Avg	**-9**	-8	-9	-8	-7	-9
Pacific Storage Level	**258**	256	255	253	251	248
Weekly Change	**+2**	+1	+2	+2	+3	+5
vs LY	**-64**	-64	-68	-70	-69	-70
vs 5Yr Avg	**-46**	-48	-50	-52	-52	-53

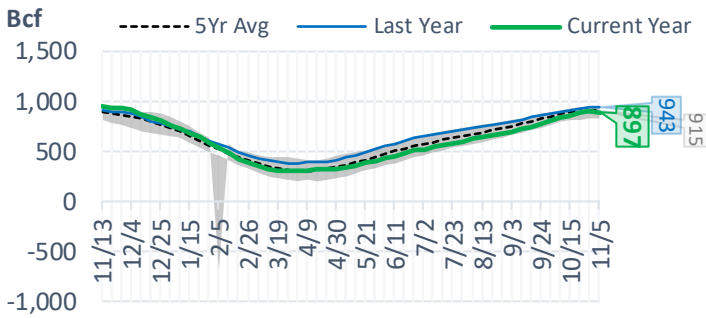
NonSalt Storage Levels



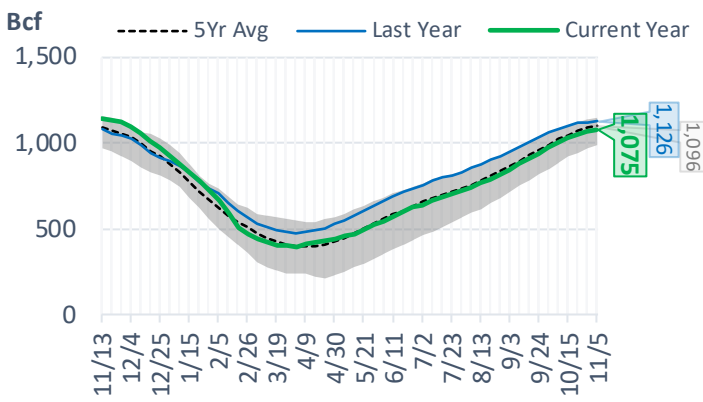
Salt Storage Levels



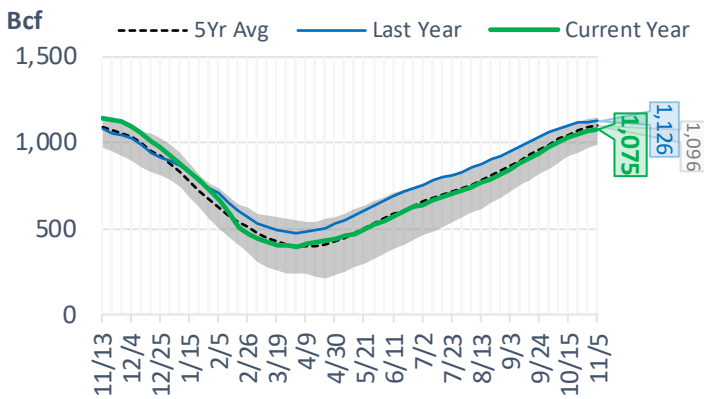
East Storage Levels



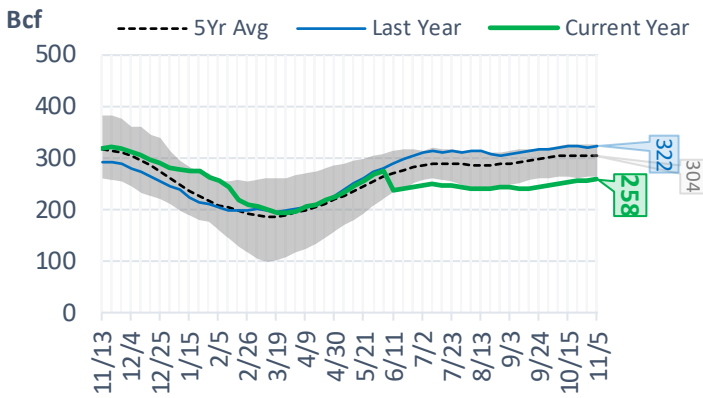
Midwest Storage Levels



Midwest Storage Levels



Pacific Storage Levels



EIA Storage Week Balances

	8-Oct	15-Oct	22-Oct	29-Oct	5-Nov	12-Nov	WoW	vs. 4W
Lower 48 Dry Production	**93.3**	**93.0**	**92.8**	**94.0**	**95.0**	**95.8**	▲ **0.8**	▲ **2.1**
Canadian Imports	**5.3**	**5.0**	**5.6**	**5.6**	**5.5**	**5.1**	▼ **-0.4**	▼ **-0.3**
L48 Power	32.9	31.7	29.0	29.0	29.5	27.3	▼ -2.1	▼ -2.5
L48 Residential & Commercial	8.1	9.5	13.9	17.7	24.1	23.4	▼ -0.7	▲ 7.1
L48 Industrial	22.2	19.9	18.9	19.5	22.9	22.0	▼ -0.9	▲ 1.7
L48 Lease and Plant Fuel	5.1	5.1	5.1	5.1	5.2	5.2	▲ 0.0	▲ 0.1
L48 Pipeline Distribution	2.2	2.2	2.3	2.5	2.9	2.7	▼ -0.2	▲ 0.2
L48 Regional Gas Consumption	**70.6**	**68.5**	**69.1**	**73.8**	**84.6**	**80.6**	▼ **-3.9**	▲ **6.7**
Net LNG Exports	**9.9**	**10.7**	**10.8**	**10.8**	**10.9**	**11.2**	▲ **0.4**	▲ **0.4**
Total Mexican Exports	**6.6**	**6.6**	**6.6**	**6.9**	**6.1**	**6.2**	▲ **0.1**	▼ **-0.3**
Implied Daily Storage Activity	**11.6**	**12.2**	**11.9**	**8.2**	**-1.0**	**2.9**	**3.9**	
EIA Reported Daily Storage Activity	**11.6**	**13.1**	**12.4**	**9.0**	**1.0**			
Daily Model Error	**0.0**	**-0.9**	**-0.5**	**-0.8**	**-2.0**			

Monthly Balances

	2Yr Ago Nov-19	LY Nov-20	Jul-21	Aug-21	Sep-21	Oct-21	MTD Nov-21	MoM	vs. LY
Lower 48 Dry Production	**96.2**	**91.1**	**93.6**	**94.1**	**93.0**	**93.4**	**95.5**	▲ **2.0**	▲ **4.4**
Canadian Imports	**4.5**	**4.6**	**5.2**	**5.1**	**5.1**	**5.4**	**5.1**	▼ **-0.2**	▲ **0.5**
L48 Power	27.5	25.7	39.4	40.1	33.1	30.3	28.7	▼ -1.6	▲ 3.0
L48 Residential & Commercial	32.8	24.4	8.1	7.8	7.7	12.9	25.0	▲ 12.1	▲ 0.6
L48 Industrial	24.9	22.5	21.2	21.7	20.8	20.3	22.6	▲ 2.3	▲ 0.1
L48 Lease and Plant Fuel	5.2	5.0	5.1	5.1	5.1	5.1	5.2	▲ 0.1	▲ 0.2
L48 Pipeline Distribution	3.0	2.7	2.5	2.6	2.2	2.3	2.9	▲ 0.6	▲ 0.2
L48 Regional Gas Consumption	**93.5**	**80.2**	**76.3**	**77.3**	**68.9**	**70.9**	**84.4**	▲ **13.5**	▲ **4.2**
Net LNG Exports	**7.2**	**10.1**	**10.8**	**10.5**	**10.3**	**10.6**	**11.0**	▲ **0.5**	▲ **0.9**
Total Mexican Exports	**5.2**	**6.1**	**7.1**	**6.9**	**6.7**	**6.6**	**6.1**	▼ **-0.5**	▲ **0.0**
Implied Daily Storage Activity	**-5.1**	**-0.7**	**4.6**	**4.5**	**12.1**	**10.7**	**-1.0**		
EIA Reported Daily Storage Activity									
Daily Model Error									

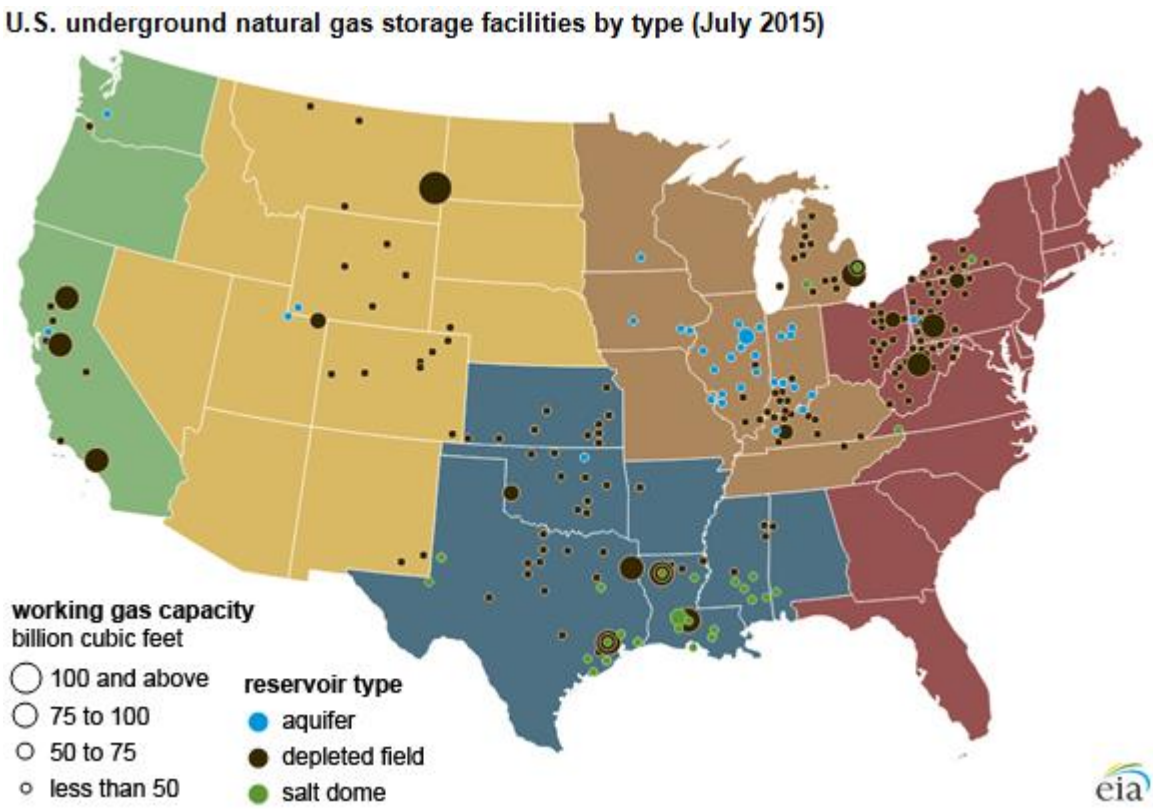
Source: Bloomberg, analytix.ai

Regional S/D Models Storage Projection

Week Ending 12-Nov

	Daily Raw Storage	Daily Adjustment Factor	Daily Average Storage Activity (Adjusted) *	Weekly Adjusted Storage Activity
L48	2.6	1.6	4.2	30
East	0.1	0.2	0.4	3
Midwest	0.3	1.2	1.5	11
Mountain	3.1	-3.1	-0.1	0
South Central	-1.6	3.5	1.8	13
Pacific	0.7	-0.2	0.5	4

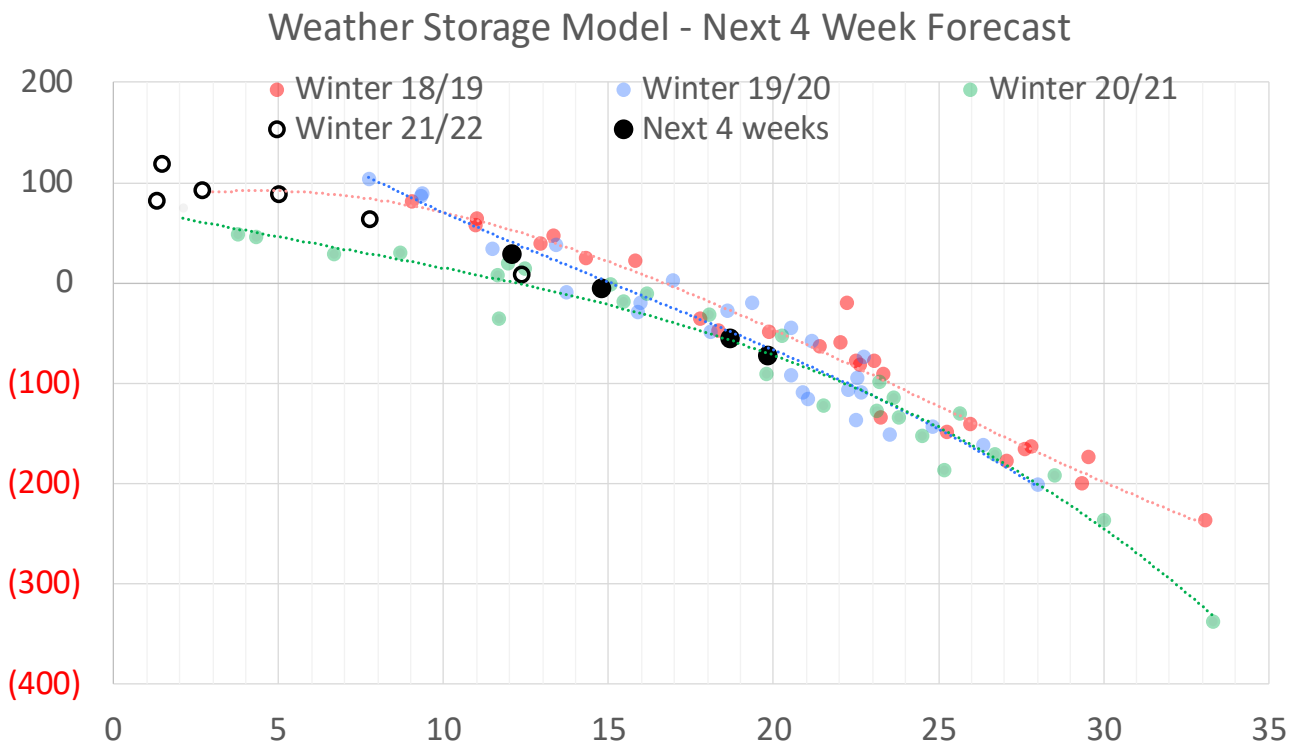
*Adjustment Factor is calcuated based on historical regional deltas



Weather Model Storage Projection

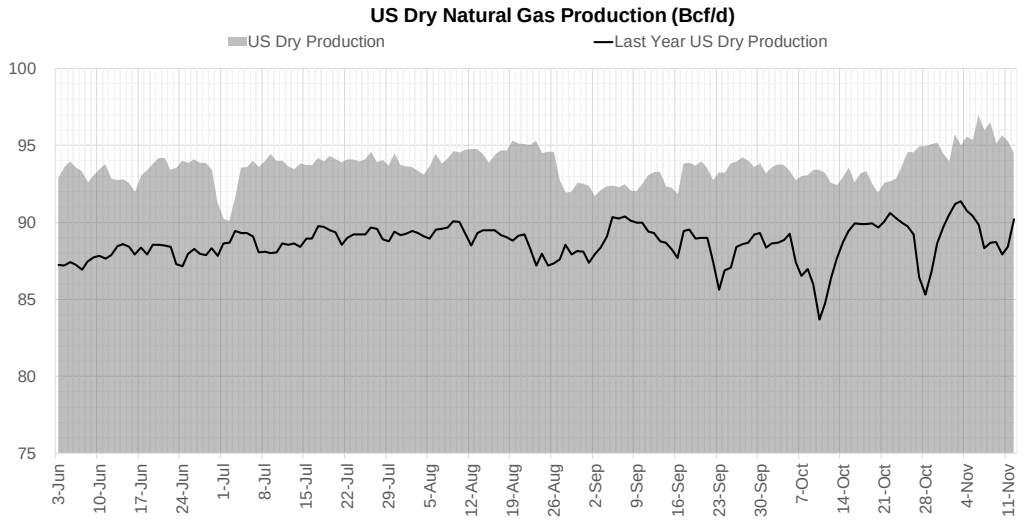
Next report and beyond

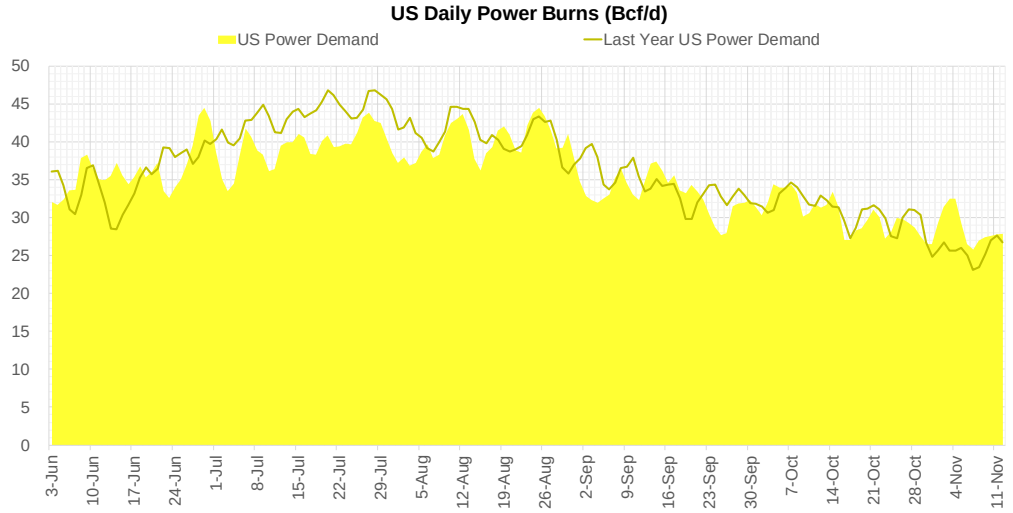
Week Ending	GWDDs	Week Storage Projection
12-Nov	12.0	30
19-Nov	15	-6
26-Nov	19	-55
03-Dec	20	-72

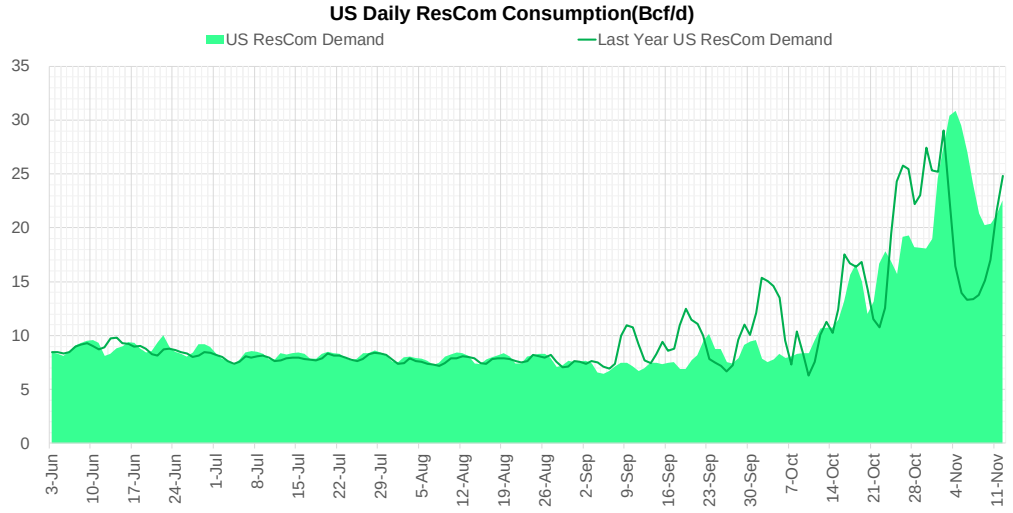


Note: this is not our official end of season forecast. This chart signifies where storage levels end with 10-year normal weather and current market tightness relative to last year

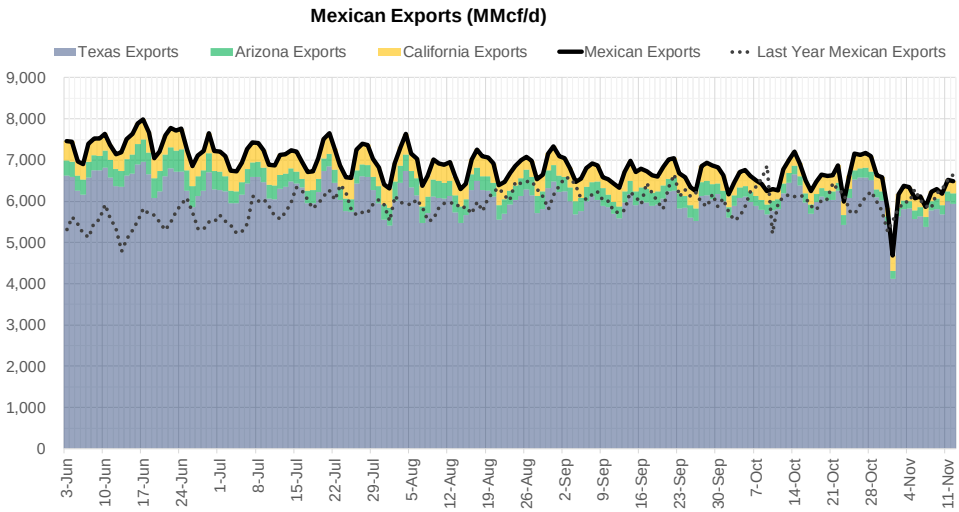
Supply – Demand Trends

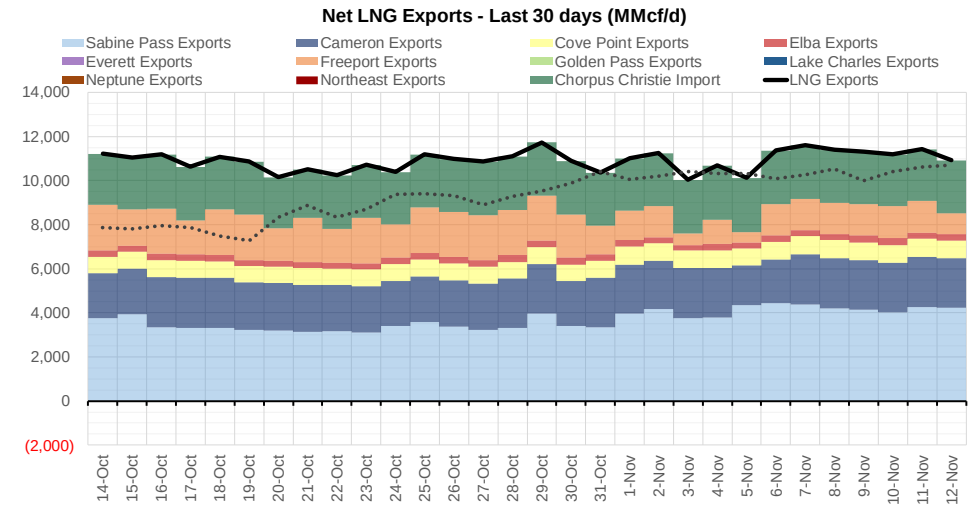






Source: Bloomberg





Source: Bloomberg

Nat Gas Options Volume and Open Interest

CME, ICE and Nasdaq Combined

CONTRACT MONTH	CONTRACT YEAR	PUT/CALL	STRIKE	CUMULATIVE VOL
12	2021	P	4.25	12560
12	2021	P	4.50	6943
12	2021	C	5.50	5274
12	2021	P	4.00	5185
12	2021	C	6.00	4252
12	2021	C	6.50	3712
1	2022	C	7.00	2713
3	2022	C	6.00	2565
12	2021	P	4.75	2557
1	2022	C	9.00	2450
3	2022	C	10.00	1972
3	2022	C	8.00	1548
3	2022	P	4.00	1504
1	2022	C	10.00	1429
1	2022	C	6.00	1090
12	2021	C	5.00	1027
12	2021	C	7.00	1025
1	2022	C	8.00	936
12	2021	P	3.75	929
12	2021	C	11.00	921
3	2022	C	5.00	860
3	2022	P	3.00	850
4	2022	C	6.00	850
3	2022	P	3.50	810
1	2023	P	3.00	780
2	2023	P	3.00	780
3	2023	P	3.00	780
12	2021	P	5.00	768
12	2021	C	12.00	720
1	2022	P	5.00	700
12	2021	C	9.00	681
12	2021	C	5.75	664
12	2021	C	6.75	613
1	2022	P	4.75	610
12	2021	C	5.30	609
1	2022	P	3.50	602
3	2022	C	4.75	590
12	2021	C	8.00	565
4	2022	P	3.00	550
12	2021	P	4.40	543
2	2022	C	6.00	530
2	2022	P	3.50	501
1	2023	P	3.50	500
2	2023	P	3.50	500
3	2023	P	3.50	500
1	2022	P	2.75	492
1	2022	C	7.50	479
12	2021	C	7.50	475
12	2021	P	4.60	471

CONTRACT MONTH	CONTRACT YEAR	PUT/CALL	STRIKE	CUMULATIVE OI
12	2021	P	2.75	54612
12	2021	P	4.00	46212
12	2021	P	3.00	40224
12	2021	P	2.50	39420
12	2021	P	3.50	34327
3	2022	C	10.00	33885
12	2021	P	4.25	27125
12	2021	C	6.00	26976
3	2022	C	8.00	25357
12	2021	P	5.00	24781
1	2022	P	3.00	23722
1	2022	C	6.00	23335
1	2022	P	2.75	22952
3	2022	C	5.00	22539
12	2021	C	4.00	22526
12	2021	C	7.00	22429
3	2022	P	3.00	21025
12	2021	C	8.00	20236
4	2022	C	3.00	19710
1	2022	P	4.00	19439
3	2022	P	2.50	18788
3	2022	P	3.50	18644
1	2022	C	7.00	18601
1	2022	P	3.50	18491
1	2022	C	5.00	18144
3	2022	P	4.00	17719
12	2021	P	4.50	17352
2	2022	C	5.00	17317
12	2021	P	2.00	16834
2	2022	P	3.50	15721
12	2022	C	5.00	15682
3	2022	C	4.00	15631
12	2021	C	5.00	15587
4	2022	P	2.50	15564
4	2022	C	5.00	15317
12	2021	C	6.50	15075
12	2021	C	7.50	14679
2	2022	P	4.00	14534
1	2022	C	4.00	14433
3	2022	C	6.00	14034
3	2022	C	7.00	13944
5	2022	C	3.00	13733
2	2022	C	6.00	13604
3	2022	P	5.00	13498
12	2021	C	15.00	13492
6	2022	C	3.00	13438
1	2022	C	8.00	13358
1	2022	C	10.00	13354
2	2022	C	4.00	13320
12	2022	C	4.5	13267

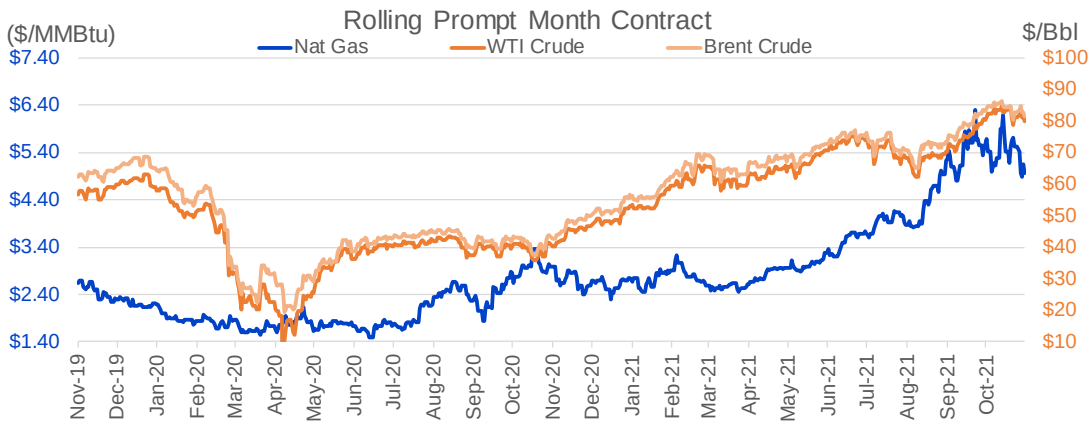
Source: CME, Nasdaq, ICE

Nat Gas Futures Open Interest

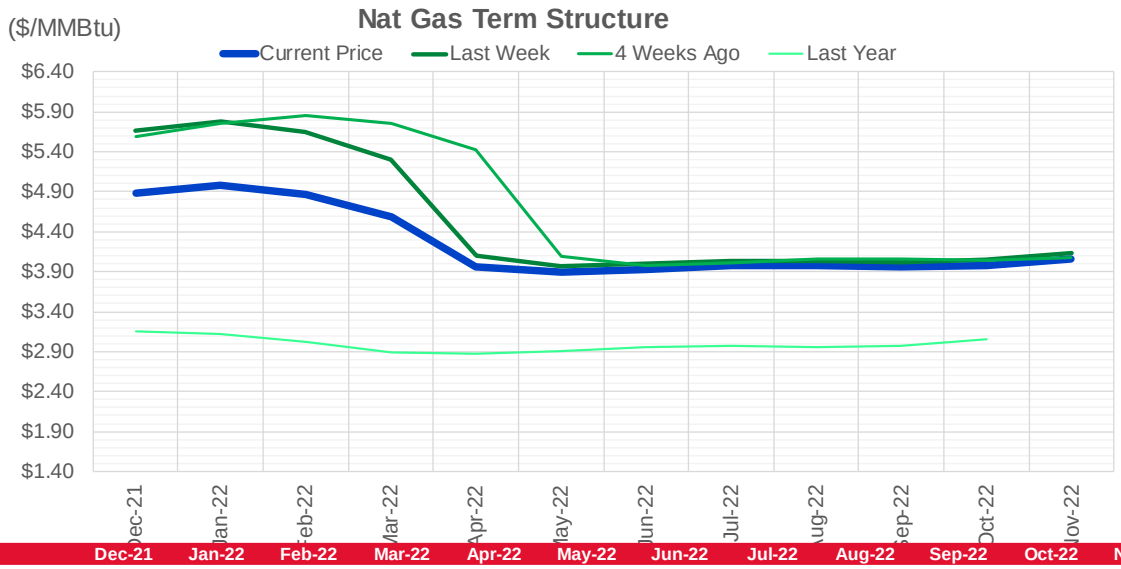
CME, ICE and Nasdaq Combined

CME Henry Hub Futures (10,000 MMBtu)				ICE Henry Hub Futures Contract Equivalent (10,000 MM			
	Current	Prior	Daily Change		Current	Prior	Daily Change
DEC 21	98935	107353	-8418	DEC 21	94242	92111	2130
JAN 22	246361	238728	7633	JAN 22	87616	87605	11
FEB 22	77910	77499	411	FEB 22	69624	69675	-51
MAR 22	155960	155635	325	MAR 22	80061	79644	417
APR 22	116403	115917	486	APR 22	77964	78236	-272
MAY 22	137050	133988	3062	MAY 22	72496	72161	335
JUN 22	43798	43798	0	JUN 22	54552	54607	-54
JUL 22	41747	41090	657	JUL 22	57519	57525	-6
AUG 22	31531	31151	380	AUG 22	55290	55677	-387
SEP 22	36713	36521	192	SEP 22	56293	56549	-256
OCT 22	86813	87419	-606	OCT 22	62137	62404	-267
NOV 22	35638	35453	185	NOV 22	48020	48374	-354
DEC 22	27499	27604	-105	DEC 22	50714	50867	-153
JAN 23	32397	31921	476	JAN 23	40326	40381	-55
FEB 23	11230	11285	-55	FEB 23	33455	33440	15
MAR 23	23000	21792	1208	MAR 23	36988	36566	422
APR 23	16757	16691	66	APR 23	37839	37610	229
MAY 23	10171	10443	-272	MAY 23	35388	35552	-164
JUN 23	8680	8593	87	JUN 23	31504	31649	-145
JUL 23	5993	5702	291	JUL 23	31464	31648	-185
AUG 23	4319	4274	45	AUG 23	32532	32724	-192
SEP 23	5782	5781	1	SEP 23	30652	30833	-180
OCT 23	10867	10740	127	OCT 23	34417	34551	-134
NOV 23	5092	5058	34	NOV 23	33979	34085	-106
DEC 23	8098	8096	2	DEC 23	31486	31588	-102
JAN 24	4782	4732	50	JAN 24	19628	19669	-41
FEB 24	1443	1443	0	FEB 24	15068	15097	-29
MAR 24	8619	8603	16	MAR 24	19808	19913	-106
APR 24	5347	5347	0	APR 24	14272	14279	-7
MAY 24	1832	1832	0	MAY 24	14863	14918	-55

Source: CME, ICE



Market Report



	Dec-21	Jan-22	Feb-22	Mar-22	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22
Current Price	**$4.880**	**$4.974**	**$4.861**	**$4.590**	**$3.967**	**$3.900**	**$3.930**	**$3.973**	**$3.977**	**$3.956**	**$3.984**	**$4.061**
Last Week	$5.670	$5.780	$5.655	$5.309	$4.104	$3.969	$3.994	$4.029	$4.034	$4.016	$4.047	$4.127
vs. Last Week	-$0.790	-$0.806	-$0.794	-$0.719	-$0.137	-$0.069	-$0.064	-$0.056	-$0.057	-$0.060	-$0.063	-$0.066
4 Weeks Ago	$5.590	$5.753	$5.854	$5.750	$5.429	$4.098	$3.977	$4.011	$4.052	$4.058	$4.042	$4.072
vs. 4 Weeks Ago	-$0.710	-$0.779	-$0.993	-$1.160	-$1.462	-$0.198	-$0.047	-$0.038	-$0.075	-$0.102	-$0.058	-$0.011
Last Year	$3.031	$3.151	$3.116	$3.026	$2.892	$2.872	$2.910	$2.957	$2.966	$2.949	$2.980	$3.047
vs. Last Year	$1.849	$1.823	$1.745	$1.564	$1.075	$1.028	$1.020	$1.016	$1.011	$1.007	$1.004	$1.014

	Units	Current Price	vs. Last Week	vs. 4 Weeks Ago	vs. Last Year
NatGas Jul21/Oct21	$/MMBtu	2.224	0.000	0.000	2.198
NatGas Oct21/Nov21	$/MMBtu	0.361	0.000	0.515	0.291
NatGas Oct21/Jan22	$/MMBtu	-0.596	-0.581	-0.691	-0.903
NatGas Apr22/Oct22	$/MMBtu	-0.004	0.038	0.027	-0.033
WTI Crude	$/Bbl	81.59	2.780	0.280	40.470
Brent Crude	$/Bbl	82.87	2.330	-1.130	39.340
Fuel Oil, NY Harbour 1%	$/Bbl	97.18	0.000	0.000	0.000
Heating Oil	cents/Gallon	244.71	4.050	-11.430	121.380
Propane, Mt. Bel	cents/Gallon	1.36	-0.009	-0.109	0.796
Ethane, Mt. Bel	cents/Gallon	0.41	-0.024	-0.036	0.187
Coal, PRB	$/MTon	12.30	0.000	0.000	0.000
Coal, PRB	$/MMBtu	0.70			

Source: CME, Bloomberg

Market Report

Baker Hughes Rig Counts

Rotary Rig Count

11/12/2021

Baker Hughes

U.S. Breakout Information	This Week	+/-	Last Week	+/-	Year Ago
Oil	454	4	450	218	236
Gas	102	2	100	29	73
Miscellaneous	0	0	0	-3	3
Directional	35	2	33	12	23
Horizontal	499	7	492	232	267
Vertical	22	-3	25	0	22

Canada Breakout Information	This Week	+/-	Last Week	+/-	Year Ago
Oil	101	6	95	62	39
Gas	67	2	65	17	50

Major Basin Variances	This Week	+/-	Last Week	+/-	Year Ago
Ardmore Woodford	0	-2	2	0	0
Arkoma Woodford	3	0	3	3	0
Barnett	1	1	0	1	0
Cana Woodford	24	2	22	13	11
DJ-Niobrara	12	0	12	9	3
Eagle Ford	41	1	40	21	20
Granite Wash	3	0	3	3	0
Haynesville	46	0	46	9	37
Marcellus	28	0	28	1	27
Permian	272	1	271	118	154
Utica	12	2	10	8	4
Williston	24	0	24	12	12