

**EXH. KCS-4
DOCKETS UE-22 ___/UG-22 ___
2022 PSE GENERAL RATE CASE
WITNESS: KYLE C. STEWART**

**BEFORE THE
WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION**

**WASHINGTON UTILITIES AND
TRANSPORTATION COMMISSION,**

Complainant,

v.

PUGET SOUND ENERGY,

Respondent.

**Docket UE-22 ___
Docket UG-22 ___**

**THIRD EXHIBIT (NONCONFIDENTIAL) TO THE
PREFILED DIRECT TESTIMONY OF**

KYLE C. STEWART

ON BEHALF OF PUGET SOUND ENERGY

JANUARY 31, 2022



WECC Markets



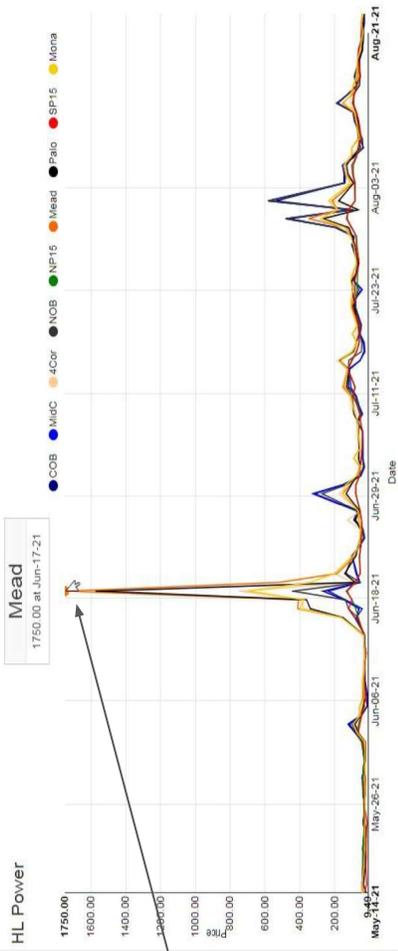
Summer 2021

WSPP - Fall 2021

Ansergy WECC - www.anserqv.com - 206-877-0991

Summer Highlights

- Record Prices
 - \$1750 at Mead on June 17, 2021
- Record heat in the Northwest
- Record dry in the Northwest



Group	Year	OR	WA	WA
NW Heat	2021	114.98	107.06	107.96
NW Heat	2009	105.08	102.92	100.04
NW Heat	2017	104.00	93.92	98.06
NW Heat	2006	104.00	96.08	100.94
NW Heat	2015	102.92	93.92	105.08
NW Heat	2012	102.02	93.02	96.98
NW Heat	2007	102.02	96.98	100.04
NW Heat	2008	100.94	91.04	102.02
NW Heat	2020	98.96	96.98	100.04
NW Heat	2018	98.96	93.02	102.02
NW Heat	2016	98.96	95.00	96.98
NW Heat	2019	98.06	91.94	98.06
NW Heat	2014	98.06	93.02	98.96
NW Heat	2010	96.98	95.00	93.92
NW Heat	2013	96.08	93.02	98.06
NW Heat	2005	95.00	89.06	96.08
NW Heat	2011	95.00	84.92	93.02

Year	Pendleton	Portland	Spokane	Seattle
2021	0.95	3.54	0.95	5.71
2015	2.87	7.26	3.65	7.32
2019	4.48	7.21	3.86	6.46
2007	3.23	7.42	4.06	8.76
2020	3.91	7.97	4.42	8.60
2018	3.47	6.68	4.62	7.82
2013	3.61	9.00	4.65	10.68
2016	4.50	9.33	4.72	8.78
2008	3.53	8.90	4.83	9.43
2014	5.64	14.19	5.98	17.03
2006	5.08	8.44	6.36	6.90
2009	5.95	9.18	6.62	10.16
2017	6.17	13.52	6.63	13.42
2010	7.08	14.28	7.07	11.45
2011	6.26	14.35	7.29	12.77
2005	4.91	15.35	8.26	12.94
2012	6.67	16.64	9.64	12.70

Mar 1 to Aug 31 cumulative inches of Precip



Warm North, Cool South (degree day anomalies)

July

HUB	CITY	MONTH	ANOM %	AVG	2021
SW	El Paso	7	-14.55%	595.38	508.74
CA	San Jose	7	-12.15%	97.94	86.04
SW	Albuquerque	7	-8.67%	424.30	387.52
SW	Phoenix	7	-8.17%	959.69	881.28
SW	Las Vegas	7	0.95%	915.05	923.72
CA	Burbank	7	7.90%	306.19	330.38
CA	Sacramento	7	8.14%	334.12	361.32
RM	Denver	7	9.35%	308.80	337.66
SW	Salt Lake City	7	19.82%	530.15	635.20
NW	Boise	7	29.70%	450.51	584.30
CA	San Diego	7	35.82%	162.46	220.65
RM	Billings	7	41.95%	305.31	433.39
NW	Portland	7	46.48%	138.13	202.32
NW	Spokane	7	67.99%	247.19	415.25
NW	Seattle	7	135.09%	51.02	119.95
Canada	Vancouver	7	171.41%	26.90	73.01
Canada	Calgary	7	244.20%	40.16	138.22

August

HUB	CITY	MONTH	ANOM %	AVG	2021
SW	Boise	8	-15.21%	360.71	305.83
SW	El Paso	8	-10.99%	553.00	492.25
SW	Salt Lake City	8	-7.75%	428.98	395.75
SW	Phoenix	8	-6.33%	919.46	861.24
CA	Burbank	8	-4.70%	329.92	314.42
SW	Albuquerque	8	-3.42%	366.32	353.79
SW	Las Vegas	8	1.90%	846.62	862.68
CA	Sacramento	8	4.34%	290.65	303.27
CA	San Jose	8	11.31%	101.29	112.75
CA	San Diego	8	13.69%	205.36	233.47
NW	Spokane	8	23.78%	189.92	235.08
RM	Billings	8	30.61%	207.31	270.77
RM	Denver	8	35.13%	240.88	325.50
NW	Portland	8	42.96%	147.97	211.53
Canada	Calgary	8	107.20%	104.08	215.64
NW	Seattle	8	113.78%	63.31	135.34
Canada	Vancouver	8	205.57%	34.37	105.04

Southwest Net Demand

REGION	RANK	PP	DATE	TEMP	NETDEM	DEMAND	NETIC
Region							
SW	1	1,310.66	08-18-2020	111	42,423	52,363	-188
SW	2	69.00	08-05-2021	107	41,946	52,022	-287
SW	3	46.04	08-20-2019	111	41,677	50,960	-713
SW	4	200.00	08-20-2020	111	41,551	51,419	-1,135
SW	5	1,643.25	08-19-2020	113	41,448	51,254	-1,643
SW	6	124.75	08-24-2020	113	41,445	51,419	-2,939
SW	7	131.88	08-04-2021	113	41,144	46,778	371
SW	8	85.17	07-08-2021	109	41,069	51,932	-2,091
SW	9	100.00	07-09-2021	111	41,061	52,380	-945
SW	10	72.32	08-05-2019	114	41,022	50,983	-673
SW	11	348.83	07-24-2018	116	40,941	50,380	-171
SW	12	309.60	09-09-2021	107	40,881	50,195	621
SW	13	97.67	07-21-2021	107	40,801	50,449	-1,532
SW	14	101.50	07-22-2021	106	40,777	49,347	60
SW	15	40.01	08-19-2019	107	40,766	49,482	372
SW	16	361.33	06-16-2021	114	40,573	51,520	-1,106
SW	17	88.41	07-19-2018	106	40,554	49,857	-463
SW	18	450.00	08-17-2020	111	40,550	51,685	-1,818
SW	19	88.00	08-27-2020	111	40,515	50,977	-1,425
SW	20	1,575.00	06-17-2021	116	40,488	51,369	-1,365

- June 17 was just the 20th most bullish day as measured by Net Demand
 - But second highest price
 - Note the randomness of price versus Net Demand
 - Aug 5, 2021 - 2nd highest net demand, price just \$99
 - Aug 20, 2019, price = \$46.04, 3rd highest Net Demand

Net Demand = Demand - Hydro - Solar - Wind - Nukes

Palo Verde

Year	date	Net Demand	Spot (ICE)	DA LMP	HA LMP	DA-HA	DA-Spot	HA-Spot
2020	8/19/2020	41,449	1,643.25	200.70	118.50	82.20	(1,442.55)	(1,524.75)
2021	6/17/2021	40,498	1,575.00	129.91	64.20	65.71	(1,445.09)	(1,510.80)
2020	8/18/2020	42,423	1,310.56	667.24	347.60	319.64	(643.32)	(962.96)
2020	9/5/2020	38,770	575.00	149.61	225.52	(75.91)	(425.39)	(349.48)
2020	9/3/2020	36,984	495.00	45.74	33.79	11.96	(449.26)	(461.21)
2020	8/14/2020	36,965	487.50	217.42	165.60	51.82	(270.08)	(321.90)
2020	8/17/2020	40,550	450.00	386.95	226.95	160.00	(63.05)	(223.05)
2021	6/16/2021	40,573	361.33	100.72	54.32	46.40	(260.61)	(307.01)
2021	6/15/2021	38,650	340.00	119.82	88.63	31.19	(220.18)	(251.37)
2021	9/9/2021	40,844	309.60	228.72	211.87	16.86	(80.88)	(97.73)
2021	7/29/2021	35,647	266.88	131.70	88.17	43.53	(135.18)	(178.71)
2020	8/20/2020	41,551	200.00	188.93	85.36	103.57	(11.07)	(114.64)
2021	7/31/2021	30,958	177.50	81.88	46.64	35.24	(95.62)	(130.86)
2020	8/15/2020	38,222	171.35	160.43	112.71	47.72	(10.92)	(58.64)
2021	7/13/2021	39,740	168.48	101.80	72.98	28.82	(66.68)	(95.50)
2021	6/14/2021	37,663	152.00	67.60	43.12	24.48	(84.40)	(108.88)
2020	8/22/2020	38,678	145.00	57.03	36.96	20.07	(87.97)	(108.04)
2021	6/19/2021	34,995	142.00	52.14	49.24	2.91	(89.86)	(92.76)
2021	9/8/2021	38,336	137.64	129.74	207.92	(78.18)	(7.90)	70.28
2021	6/28/2021	34,981	134.00	79.67	52.02	27.65	(54.33)	(81.98)
2021	7/10/2021	37,679	132.50	82.49	90.01	(7.52)	(50.01)	(42.49)
2021	8/4/2021	41,144	131.88	101.47	89.94	11.53	(30.41)	(41.94)
2020	8/24/2020	41,445	124.75	68.71	137.81	(69.10)	(56.04)	13.06
2021	8/3/2021	36,851	123.62	96.05	72.82	23.23	(27.57)	(50.80)
2020	9/8/2020	25,925	120.00	83.44	22.06	61.38	(36.56)	(97.94)

- Poor correlations
 - Net Demand and Price
 - ICE Day Ahead vs ISO LMP
 - DA vs HA
- August 19, 2020
 - ICE = \$1643.25
 - DALmp = \$200.70
 - HALmp = 118.50
- DA is almost always greater than HA
 - More uncertainty, more risk in DA
 - Friday for Monday Effect

ISO Rule Changes

Market Enhancements for Summer 2021 Readiness

“Based on the Root Cause Analysis and related discussions and analysis, the CAISO has determined it is appropriate to modify the relevant priorities the CAISO market places on serving CAISO balancing authority area load relative to exports from and wheeling schedules across the CAISO balancing authority area.”

1. Outside hubs now carry a premium to ISO
 - a. Greatest premium on high-risk days
2. Southwest (Mead and PV) risks are greater than MidC during Summer
 - a. Winter could see significant MidC Premiums whenever it is cold in both the ISO and the Northwest
3. Overly Cautious ISO
 - a. Cuts DA, but honors HA schedules
 - b. Massive Impact on Outside ISO ratepayers

ICE Day Ahead is Broken

Region	year	Cost to Serve Load (millions)						
		DA	HA	ICE	Day Ahead	Hour Ahead	ICE	ICE - DA
NC	2019	32.70	33.74	32.70	\$923	\$962	\$923	\$0
NC	2020	39.64	43.07	39.64	\$1,096	\$1,223	\$1,096	\$0
NC	2021	67.14	64.41	67.14	\$1,803	\$1,760	\$1,803	\$0
NW	2019	31.07	27.61	26.68	\$34	\$30	\$29	\$5
NW	2020	37.71	34.33	24.79	\$1,153	\$1,062	\$764	\$389
NW	2021	65.51	58.91	81.38	\$2,101	\$1,889	\$2,668	\$567
RM	2019	31.07	27.61	24.89	\$7	\$6	\$6	\$1
RM	2020	37.71	34.33	46.69	\$259	\$240	\$183	\$76
RM	2021	65.51	58.91	86.60	\$466	\$416	\$594	\$128
SC	2019	34.10	33.32	34.10	\$1,248	\$1,228	\$1,248	\$0
SC	2020	52.49	42.55	52.49	\$1,983	\$1,577	\$1,983	\$0
SC	2021	67.72	62.61	67.72	\$2,385	\$2,215	\$2,385	\$0
SW	2019	32.51	31.65	35.41	\$2,069	\$2,099	\$2,275	\$206
SW	2020	51.93	41.67	89.64	\$3,539	\$2,830	\$6,159	\$2,620
SW	2021	66.35	58.93	99.45	\$4,333	\$3,885	\$6,728	\$2,395
WECC	2019	32.12	30.33	31.00	\$4,281	\$4,326	\$4,481	\$200
WECC	2020	44.62	38.75	53.78	\$8,030	\$6,932	\$10,186	\$2,156
WECC	2021	66.25	59.96	84.68	\$11,088	\$10,165	\$14,178	\$3,090

- ICE DA delta to LMP grew in 2021
 - 2019 = \$1.12
 - 2020 = \$9.16
 - 2021 = \$18.43
- HA < DA in all years
- \$3.09 Billion (ICE vs DA) in 2021
 - SW = \$2.4 Billion
 - NW = \$0.6 Billion

ICE Day Ahead is a poor index to settle term swaps (fixed for float)

All values are On Peak; NW - Captain Jack; PV - Palo Verde; NEVP - Mead; PACE - Mona

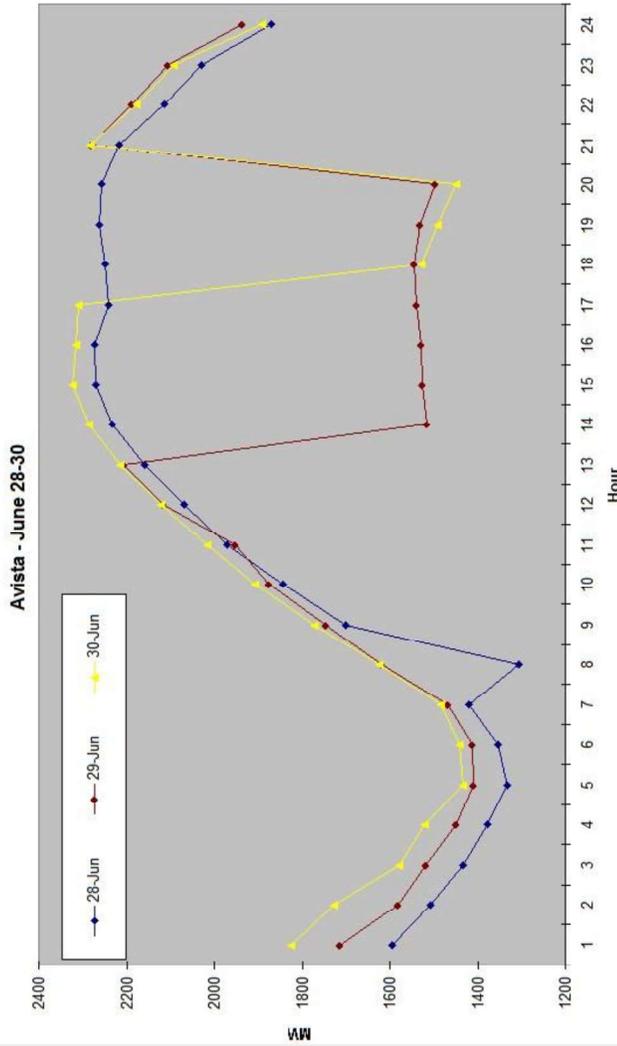
Winter MidC Imports from ISO

Date	HR	ToISO
2/5/2019	11	-2,985
2/5/2019	10	-2,942
2/6/2019	13	-2,931
2/6/2019	12	-2,925
2/6/2019	15	-2,924
2/6/2019	14	-2,892
2/5/2019	13	-2,843
2/5/2019	15	-2,836
2/5/2019	12	-2,797
2/6/2019	11	-2,699
2/5/2019	14	-2,654
2/6/2019	10	-2,546
2/28/2019	15	-2,488
2/28/2019	14	-2,478
2/6/2019	16	-2,474
3/1/2019	5	-2,387
2/28/2019	13	-2,381
3/10/2019	13	-2,380
2/5/2019	16	-2,351
3/3/2019	13	-2,349
3/1/2019	6	-2,333
3/1/2019	24	-2,328
3/3/2019	14	-2,308
3/1/2019	4	-2,265
2/28/2019	11	-2,265
3/10/2019	14	-2,259

- In 2019, the MidC leaned on the ISO to meet demand
 - Will the ISO honor those schedules?
 - Will the MidC Day Ahead carry large Liquidated Damage premiums in the ICE DA settles?
- Will only occur if the ISO is cold and struggles to meet its demand
 - Or, ISO cuts DA “just to be safe”
 - Big LD premiums for MidC Winters?

A New Strategy to Serve Load?

orgcode	Hour	28-Jun	29-Jun	30-Jun
AVA	1	1595	1715	1825
AVA	2	1508	1581	1727
AVA	3	1434	1518	1578
AVA	4	1377	1449	1521
AVA	5	1333	1408	1434
AVA	6	1353	1413	1440
AVA	7	1419	1468	1483
AVA	8	1306	1619	1623
AVA	9	1701	1746	1772
AVA	10	1844	1875	1906
AVA	11	1970	1953	2016
AVA	12	2069	2117	2122
AVA	13	2160	2206	2214
AVA	14	2232	1515	2285
AVA	15	2270	1525	2322
AVA	16	2273	1528	2314
AVA	17	2242	1539	2310
AVA	18	2248	1545	1528
AVA	19	2261	1532	1491
AVA	20	2256	1498	1450
AVA	21	2218	2282	2284
AVA	22	2114	2188	2177
AVA	23	2028	2107	2093
AVA	24	1871	1937	1891
	28-Jun	1,724	1,799	1,830
No Cut Average		-	75	106
Increase in Load		2,255	1,526	1,490
Average Cut Hours		-	(729)	(765)
Average Cut		0	7	3
Hours Cut				



- The utility cut 700 aMW of its load on the hottest hours
 - No other utility cut, the estimated peak demand delta from June 28 to June 29 or 30 was just 100 MWs
- Why cut 700 MW of Demand?
 - Either economics (save \$\$\$) or a blunder
- Is this the future of US power?

Part Two:

Northwest Summers

1. The Northwest realized its highest summer peak demand
 - a. Hottest temperatures
 - b. Growing AC load
2. **Materially higher summer loads in 2022**
 - a. Significant AC build out
3. **Increases pressure on WECC Summers**

Top 15 Northwest Peak Demand

REGION	RANK	PP	DATE	HOUR	TEMP	NETDEM	DEMAND
Region							
NW	1	315.52	06-28-2021	20	114	6,524	26,230
NW	2	146.30	06-29-2021	19	91	6,333	25,601
NW	3	124.65	08-12-2021	15	102	9,237	25,575
NW	4	182.56	08-11-2021	19	102	9,066	25,386
NW	5	60.02	06-26-2021	21	107	5,956	25,205
NW	6	155.35	08-04-2021	19	95	9,015	25,192
NW	7	481.79	07-29-2021	19	96	9,398	25,156
NW	8	69.93	08-13-2021	17	96	9,477	25,113
NW	9	80.83	06-27-2021	15	111	5,896	25,079
NW	10	131.15	08-09-2018	17	95	7,185	24,968
NW	11	214.62	07-25-2018	18	96	5,431	24,816
NW	12	54.42	07-16-2018	18	96	5,407	24,808
NW	13	148.44	08-02-2021	19	91	9,423	24,789
NW	14	39.63	07-17-2018	18	89	2,142	24,778
NW	15	147.83	08-08-2018	18	93	6,659	24,652

- NW hit highest summer peak - 26,230 MW
- 9 of 10 highest summer peaks were in 2021
- 1250 MW > #10 (Aug 9, 2018)
 - June 29 should have been 750 higher, but for forced load shedding.

2022 and Beyond

- Higher peaks
- Northwest competes with ISO super-peak hours
 - Cuts exports to ISO

The WECC's Problem with Wind

Region	Shoulder	Summer	Winter
No California	-41.17%	-28.29%	-14.90%
Northwest	-42.69%	-41.81%	-50.60%
Rockies	7.94%	-30.53%	-6.35%
So California	-53.26%	-31.65%	-54.18%
Southwest	10.19%	3.86%	-8.52%
WECC	-17.82%	-26.25%	-16.65%

- All Regions realize less wind on high demand days
- Rockies and Southwest highest correlations
- Northwest the least correlated
 - Across all seasons

Wind is unreliable on Northwest's peak demand days

Compares Wind output for the top 50 Demand days against the bottom 200.

Percent Change = (Top - Bottom) / (Bottom)

- Summer - June to September
- Winter - November to March
- Shoulder - October, April, May

Solar Factors

Region	month	loadper	solarper	windper
No California	8	132.41%	89.93%	28.64%
Northwest	8	121.27%	163.81%	56.61%
Rockies	8	120.31%	114.28%	69.58%
So California	8	138.96%	82.72%	73.89%
Southwest	8	114.77%	89.59%	69.93%

Solar performs much better than wind, in all seasons, on peak demand days.

Is it time for the Northwest to consider Solar Farms to serve Summer Peak?

A Case for Northwest Solar

Month	Cloud Cover
6	13.21%
7	3.47%
8	5.55%

- Average summer cloud cover for Moses Lake, WA - 2005 to 2021
 - Comparable to the Southwest deserts
 - Even better Irradiance around Hanford, WA
- The Northwest's pre-built Battery - Hydro

Hydro - Northwest's Pre-built Battery

Hour	y20	y21	delta	Min	Max	Shaping Capacity
1	7,932	6,258	-1,675	3,564	17,554	2,694
2	7,740	6,063	-1,676	3,564	17,554	2,499
3	7,662	5,922	-1,740	3,564	17,554	2,358
4	7,712	5,923	-1,789	3,564	17,554	2,359
5	8,067	8,628	561	3,564	17,554	5,064
6	8,873	7,755	-1,118	3,564	17,554	4,191
7	9,167	8,600	-567	3,564	17,554	5,036
8	9,379	7,740	-1,639	3,564	17,554	4,176
9	9,680	7,664	-2,016	3,564	17,554	4,100
10	10,025	7,880	-2,146	3,564	17,554	4,316
11	10,335	8,163	-2,172	3,564	17,554	4,599
12	10,729	8,577	-2,151	3,564	17,554	5,013
13	10,959	8,961	-1,998	3,564	17,554	5,397
14	11,144	9,330	-1,814	3,564	17,554	5,766
15	11,182	9,702	-1,480	3,564	17,554	6,138
16	11,334	10,571	-763	3,564	17,554	7,007
17	11,405	11,484	79	3,564	17,554	7,920
18	11,356	11,072	-284	3,564	17,554	7,508
19	11,067	10,794	-273	3,564	17,554	7,230
20	10,841	10,222	-620	3,564	17,554	6,658
21	10,347	9,843	-504	3,564	17,554	6,279
22	9,282	9,039	-243	3,564	17,554	5,475
23	8,722	7,271	-1,451	3,564	17,554	3,707

- Hydro energy from USACE actual energy reports
- August 2020 vs 2021
- Does not include all Northwest hydro

Observations

- More shaping in 2021
- Around 4000 MWs of available solar shaping
 - Suggests 5000 MW of installed solar could be shaped into evening peak

ISO's Over-reliance on Northwest Hydro

July

Month	Hour	y2020	y2021	Delta
7	1	6,712	4,308	-2,404
7	2	6,747	4,312	-2,435
7	3	6,754	4,301	-2,453
7	4	6,758	4,258	-2,500
7	5	6,746	4,241	-2,504
7	6	6,638	4,204	-2,429
7	7	6,100	3,779	-2,321
7	8	5,331	3,079	-2,252
7	9	5,252	2,936	-2,316
7	10	5,376	2,809	-2,567
7	11	5,686	2,864	-2,821
7	12	5,741	2,933	-2,808
7	13	5,967	2,965	-3,002
7	14	6,097	3,150	-2,948
7	15	6,055	3,213	-2,843
7	16	6,179	3,569	-2,610
7	17	6,314	3,799	-2,515
7	18	6,428	3,996	-2,432
7	19	6,678	4,367	-2,311
7	20	6,723	4,428	-2,295
7	21	6,604	4,336	-2,268
7	22	6,589	4,381	-2,208
7	23	6,617	4,354	-2,262
7	24	6,647	4,366	-2,281

August

Month	Hour	y2020	y2021	Delta
8	1	6,241	3,872	-2,369
8	2	6,285	3,845	-2,440
8	3	6,260	3,833	-2,427
8	4	6,257	3,835	-2,422
8	5	6,179	3,878	-2,301
8	6	6,181	4,409	-1,772
8	7	5,976	4,120	-1,856
8	8	5,362	3,254	-2,108
8	9	5,157	3,178	-1,980
8	10	5,324	3,063	-2,260
8	11	5,514	3,069	-2,445
8	12	5,639	3,088	-2,551
8	13	5,796	3,258	-2,538
8	14	5,993	3,404	-2,589
8	15	5,887	3,482	-2,405
8	16	5,953	3,996	-1,957
8	17	6,057	4,282	-1,775
8	18	6,129	4,553	-1,576
8	19	6,294	4,849	-1,445
8	20	6,312	4,934	-1,378
8	21	6,479	4,779	-1,700
8	22	6,256	4,392	-1,864
8	23	6,191	4,210	-1,981
8	24	6,207	4,234	-1,973

- July 2021 averaged 2500 aMW less than 2020 (AC+DC)
 - The equivalent of losing both Diablo units
- August about 2000 aMW
- 87% normal water year, what if it was a 70%?
- 2021 shaped ISO solar more than 2020

Conclusions

1. Markets are changing, driven as much by regulation as fundamentals
 - a. Re-ISO Export rule changes
2. Northwest will increasingly compete for peak summer energy
 - a. Growing AC load
 - b. ISO will suffer the most through decreased northwest exports
 - c. Utilities may voluntarily elect to serve demand; pass the buck to their customers
3. Wind is a poor resource on peak demand days
 - a. Except the Rockies and Southwest
 - b. When it's very hot or very cold, wind doesn't blow
4. Northwest should consider adding large scale solar farms
 - a. Build up to 5000 MWs of solar farms in eastern Oregon and Washington
 - b. Shape the solar peak using its abundant hydro shaping capacity