Load Forecasting Update

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NYSRC – Installed Capacity Subcommittee

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Agenda

- Fall Forecast Update – Large Interconnecting Loads
- Updated Load Duration Analysis
- Behind-the-Meter (BTM) Solar Adjusted Load Duration Curve Analysis

Large Load Interconnections Forecast Update

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Load Forecast Update

- The upcoming IRM Fall Forecast Update will consider the forecast from the 2021 Load and Capacity Data Report ("Gold Book"), updated load growth projections from the Transmission Owners, the latest weather normalization results, and other factors
- In addition, the impact of the following additional load projects will be considered (the total MW additions for each Zone impacted by these changes are shown on the following slide):
  - Q580 – WNY STAMP
  - Q776 – Greenidge Load
  - Q849 – Somerset Load
  - Q850 – Cayuga Load
  - Q979 – North Country Data Center (load increase)

Load Assumptions

- **Increased zonal load forecasts based on load queue project additions are shown below**
  - Only zones with changes based on queue projects are shown in this figure
  - Updated projections will be discussed with the TOs as part of the Fall Forecast Update

Annual Energy GWh Delta					
Year	A	B	C	D	NYCA
2021	0	0	0	0	0
2022	860	0	160	620	1,640
2023	2,130	0	570	1,120	3,820
2024	2,490	0	740	1,280	4,510
2025	2,840	0	900	1,450	5,190
2026	3,210	0	900	1,620	5,730
2027	3,400	0	900	1,780	6,080
2028	3,400	0	900	1,780	6,080
2029	3,400	0	900	1,780	6,080
2030	3,400	0	900	1,780	6,080
2031	3,400	0	900	1,780	6,080

Summer Peak MW Delta					
Year	A	B	C	D	NYCA
2021	0	0	0	0	0
2022	90	0	10	75	175
2023	265	0	70	135	470
2024	325	0	90	155	570
2025	385	0	110	175	670
2026	445	0	110	195	750
2027	485	0	110	215	810
2028	485	0	110	215	810
2029	485	0	110	215	810
2030	485	0	110	215	810
2031	485	0	110	215	810

Winter Peak MW Delta					
Year	A	B	C	D	NYCA
2021-22	50	0	0	0	50
2022-23	180	0	40	125	345
2023-24	295	0	80	145	520
2024-25	355	0	100	165	620
2025-26	415	0	110	185	710
2026-27	465	0	110	205	780
2027-28	485	0	110	215	810
2028-29	485	0	110	215	810
2029-30	485	0	110	215	810
2030-31	485	0	110	215	810
2031-32	485	0	110	215	810

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Updated Load Duration Analysis

Load Duration Curve (LDC)

- A load duration curve shows per-unit load values by ranked day or hour, sorting summer loads from any given historical year from highest to lowest.
- Per-unit load values are daily or hourly MW values expressed as a percentage of the summer peak MW value.
- The purpose of a load duration curve analysis is to assess how near-peak load days and hours compare to the summer peak load hour for any historical year.
- Higher relative near-peak load days and hours generally result in more stressed system load conditions, while lower relative near-peak load days and hours generally result in less stressed system load conditions.
- The load duration curve analysis conducted for discussion today analyzes load duration curves as found, and investigates the impacts of increasing penetration of behind-the-meter (BTM) Solar between 2012 and 2022 in order to identify potential differences in the load duration curves caused by these changes.

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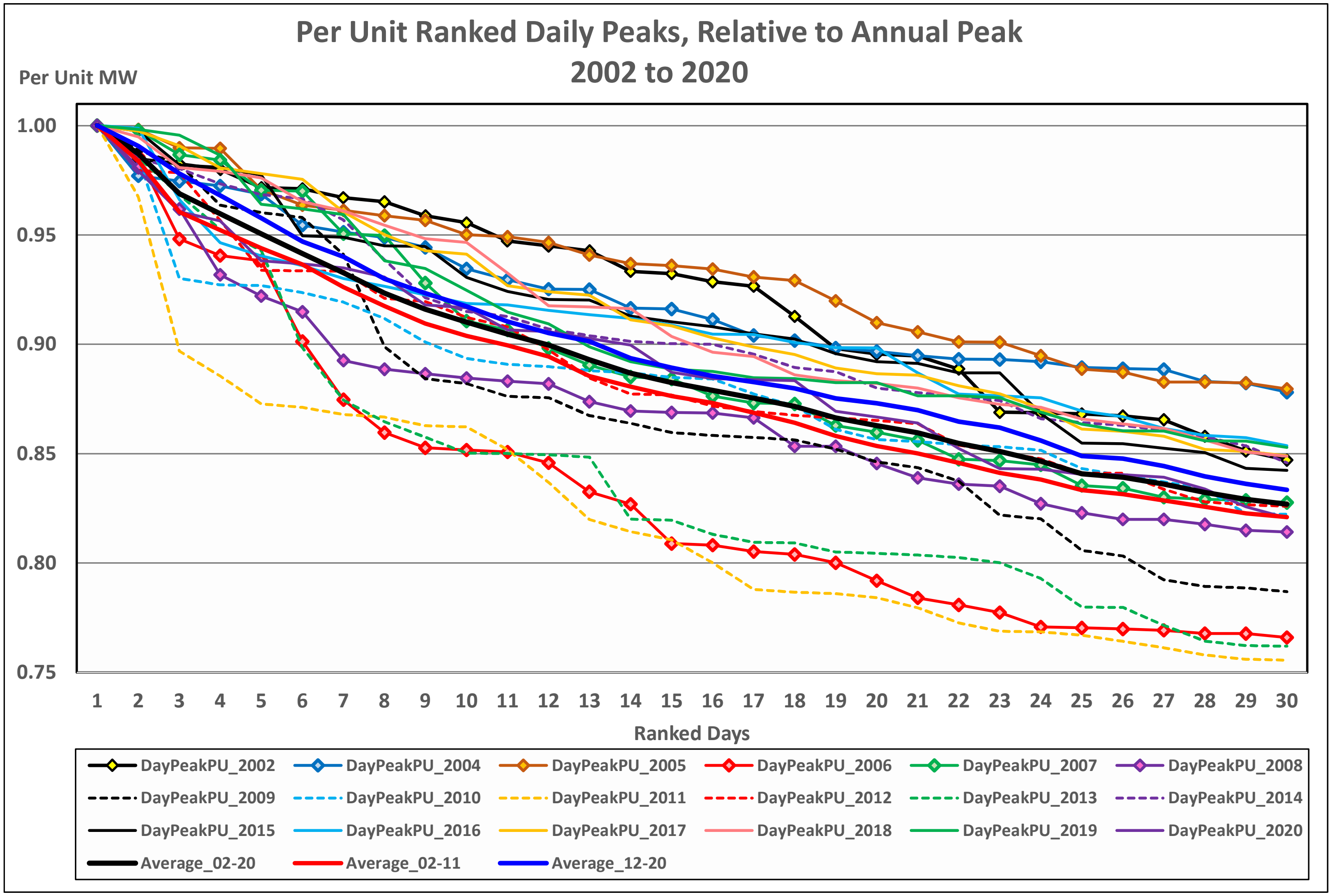
Analysis Methodology

- **All analysis performed at the system level**
- **All load values add back estimated NYISO program demand response impacts**
- **Standard Load Duration Curve (LDC) Analysis for 2002 through 2020 summers (no BTM Solar adjustment)**
  - 2003 excluded due to the blackout
  - Daily LDC comparison
  - Hourly LDC comparison
  - Comparison of LDCs between hotter and cooler summers, determined by peak day Cumulative Temperature & Humidity Index (CTHI)
- **Load Duration Curve (LDC) Analysis for the 2012 through 2020 summers was repeated to capture the impacts of behind-the-meter (BTM) Solar**
  - BTM solar impacts for each historical year were scaled up to reflect the 2022 projected BTM solar capacity – creating adjusted load shapes
  - Comparison of historical NYCA peak date daily load shapes – actual vs. adjusted and gross load shape comparison
  - Analysis of daily and hourly adjusted LDCs

Standard Load Duration Curve Analysis – Daily LDCs



- Per-unit loads (relative to annual peak) of top 30 days
- Three averages were calculated: 2002-2011, 2012-2020, and 2002-2020. All are fairly similar
- 2002 has a very flat slope
- 2007 has a fairly typical slope
- 2006, 2011 and 2013 have relatively steep slopes

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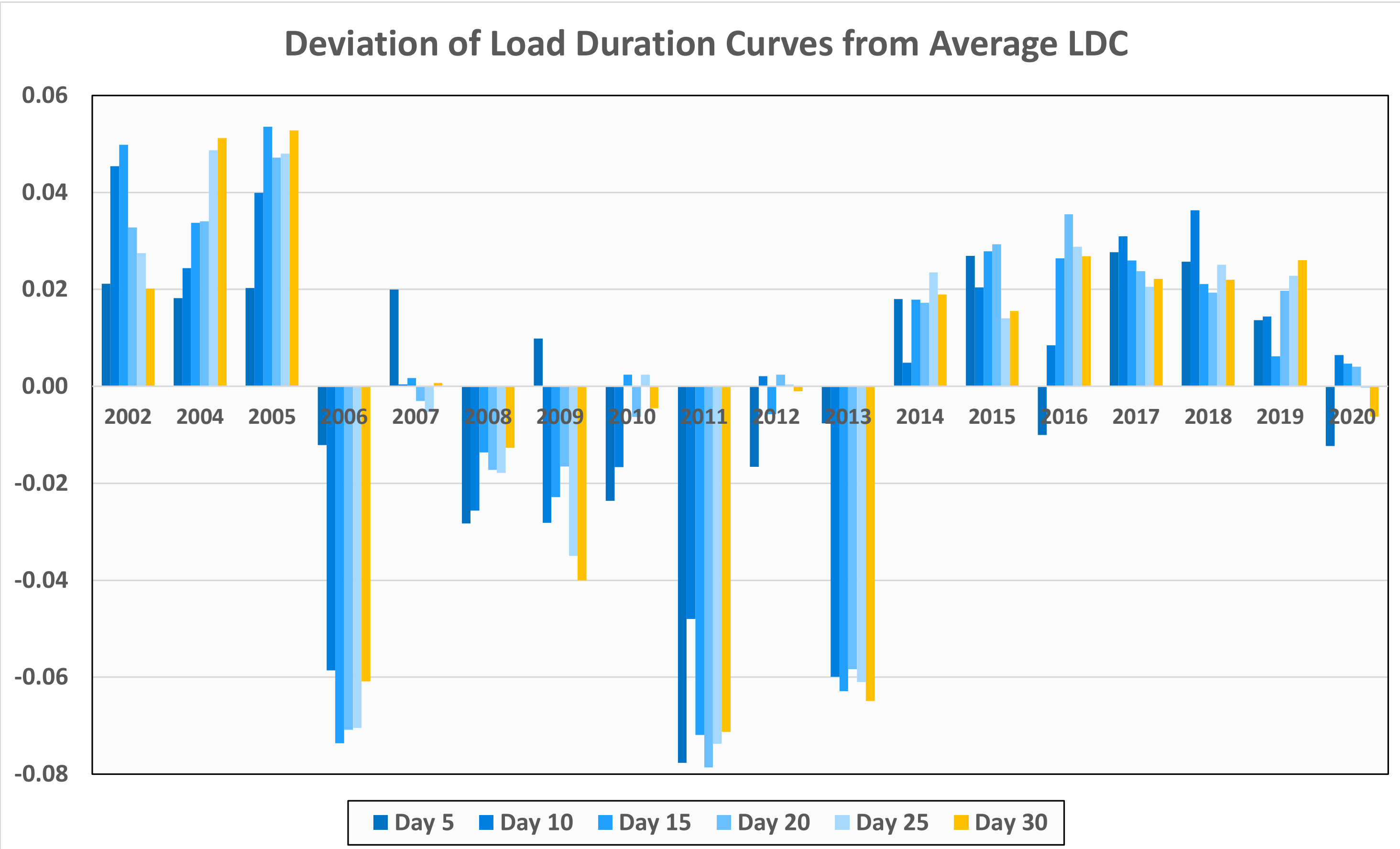

- 2002 through 2005 are generally above average (flatter LDCs)
- 2006, 2011 and 2013 are significantly below average (steeper LDCs)
- 2014 through 2019 are generally above average
- 2020 is fairly close to average

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Annual Load Duration Curve and Peak Weather Metrics with Rankings						
Year	**10-day Load Factor**	**Peak Day CTHI**	**Peak MW (incl DR)**	**Rank Load Factor**	**Rank CTHI**	**Rank MW**
2002	0.974	83.03	31,142	2	11	11
2004	0.963	81.40	28,433	8	16	18
2005	0.974	82.92	32,071	1	13	10
2006	0.915	87.60	34,686	17	2	3
2007	0.965	82.00	32,169	7	15	9
2008	0.926	84.61	32,432	15	6	6
2009	0.946	82.27	30,844	13	14	14
2010	0.932	86.70	33,839	14	3	4
2011	0.895	87.74	35,262	18	1	1
2012	0.947	83.26	33,186	12	10	5
2013	0.919	86.56	34,729	16	4	2
2014	0.961	80.54	29,782	9	17	16
2015	0.966	82.95	31,138	6	12	12
2016	0.949	83.41	32,282	10	9	7
2017	0.972	80.38	29,699	3	18	17
2018	0.971	84.59	32,280	4	7	8
2019	0.966	84.96	30,480	5	5	15
2020	0.947	83.56	31,037	11	8	13

- Comparison of the load duration curve to the peak weather and load for that year
- Hot summers (CTHI above the 70th percentile) are shaded in red; cool summers (CTHI below the 30th percentile) are shaded in blue
- The three steepest load duration curves are from the four hottest summers and the three highest peak load days
- A steep load duration curve is most characteristic of load behavior during summers with extreme peak day heat

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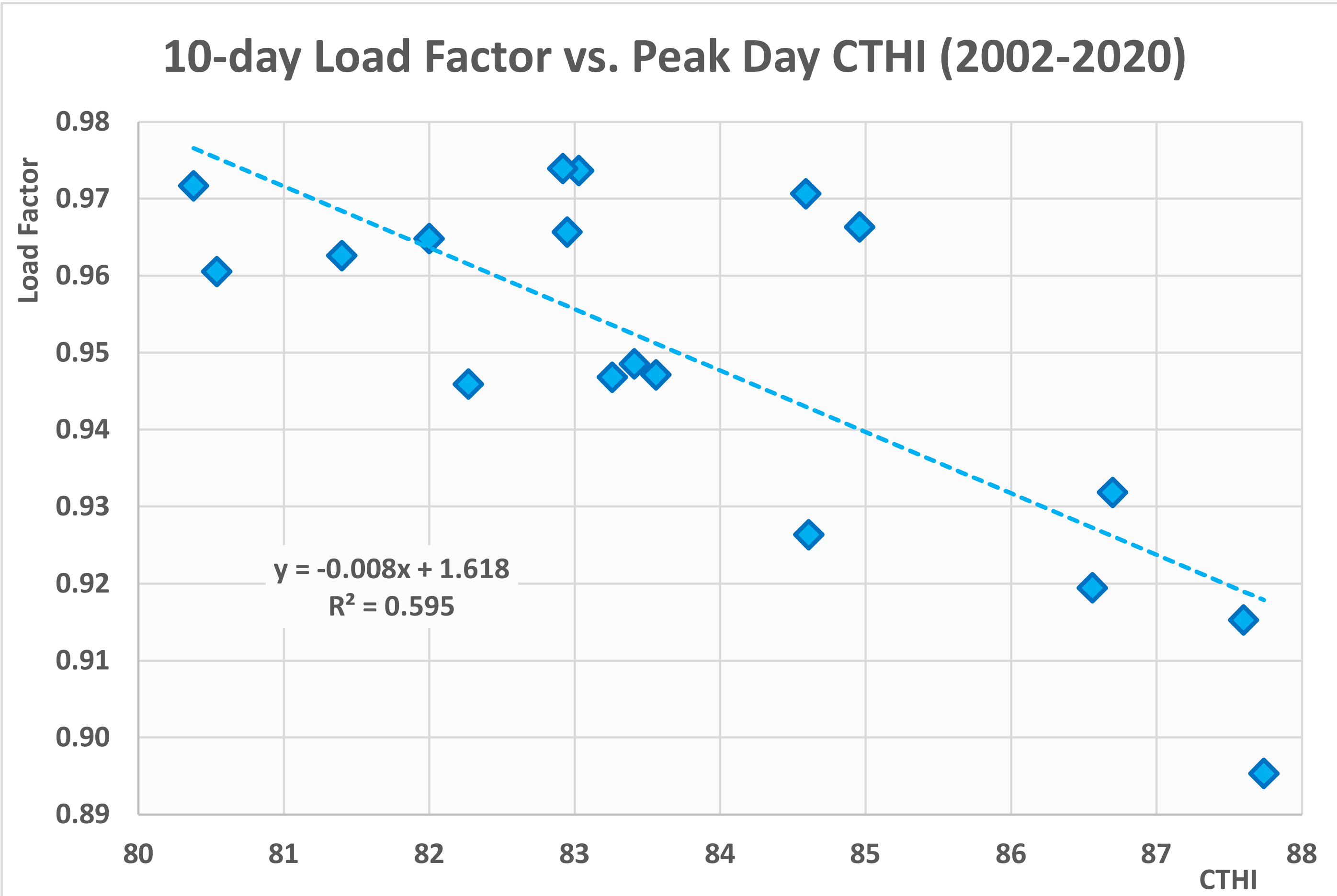
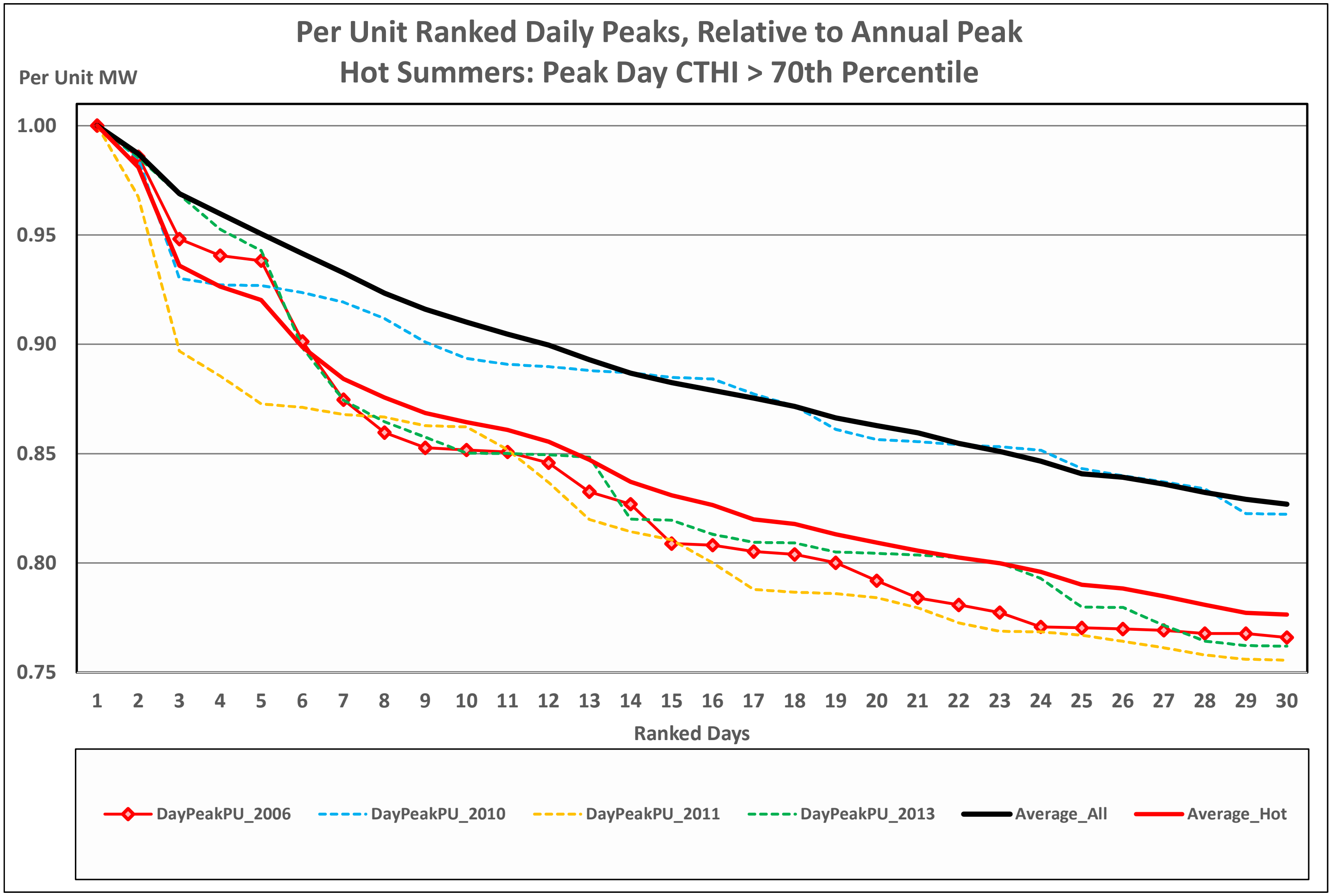
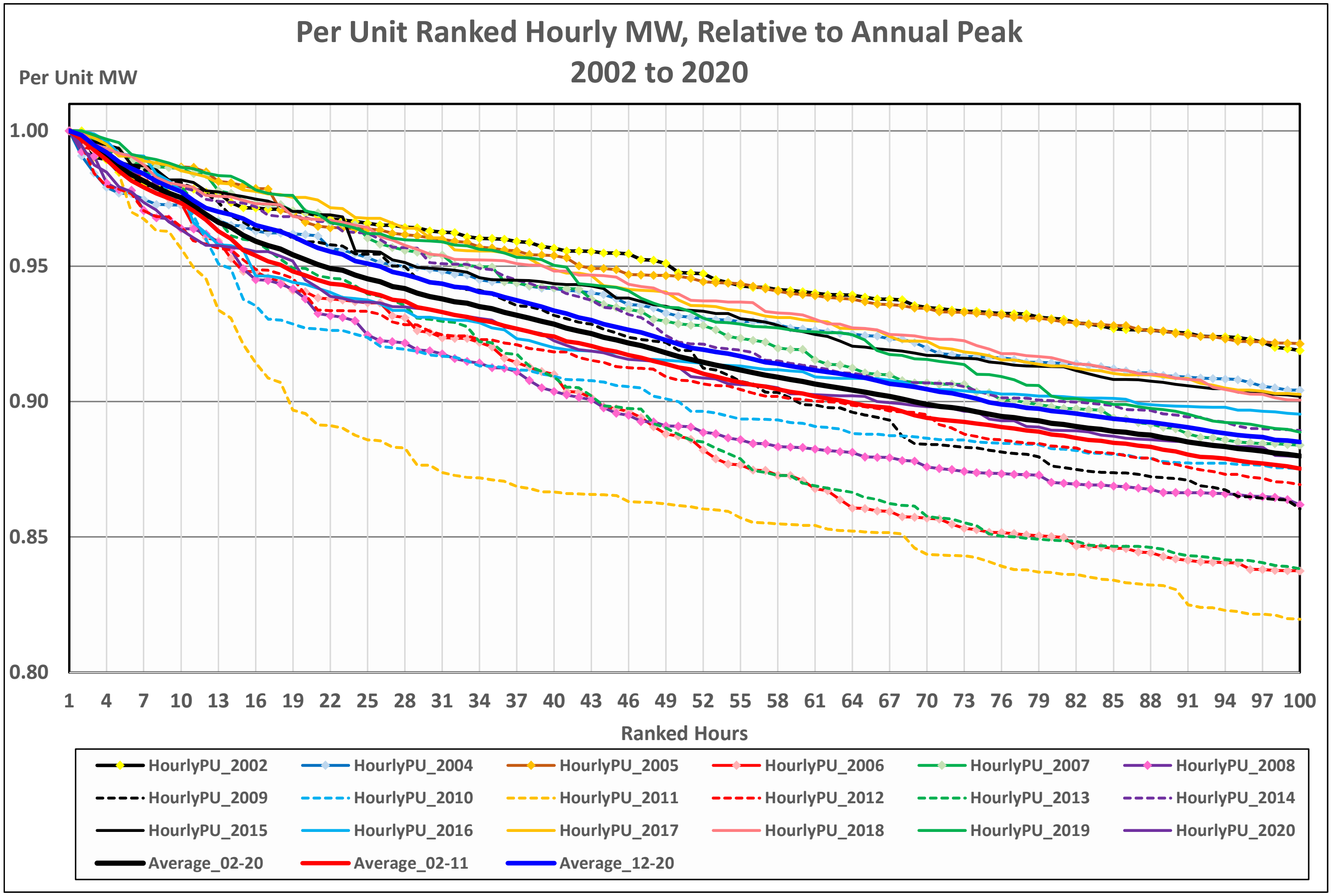


- There is a significant negative correlation between peak day weather and flatness of the load duration curve
- Years with flatter LDCs represent summers with typical or cooler peak weather



- 2006, 2010, 2011 and 2013 are the four summers with significantly hotter than normal peak-producing weather conditions
- The average of this subset is significantly lower than the overall average across all years
- These curves better represent expected load behavior applicable to the upper bin LFU multipliers (Bins 1 to 3)

Standard Load Duration Curve Analysis – Hourly LDCs



- This graph shows the hourly LDCs for all summers in the analysis. The top 100 summer hours are shown
- These LDCs are comparatively similar to the daily LDCs across years
- 2002 has a very flat slope
- 2007 has a fairly typical slope
- 2006, 2011 and 2013 have relatively steep slopes

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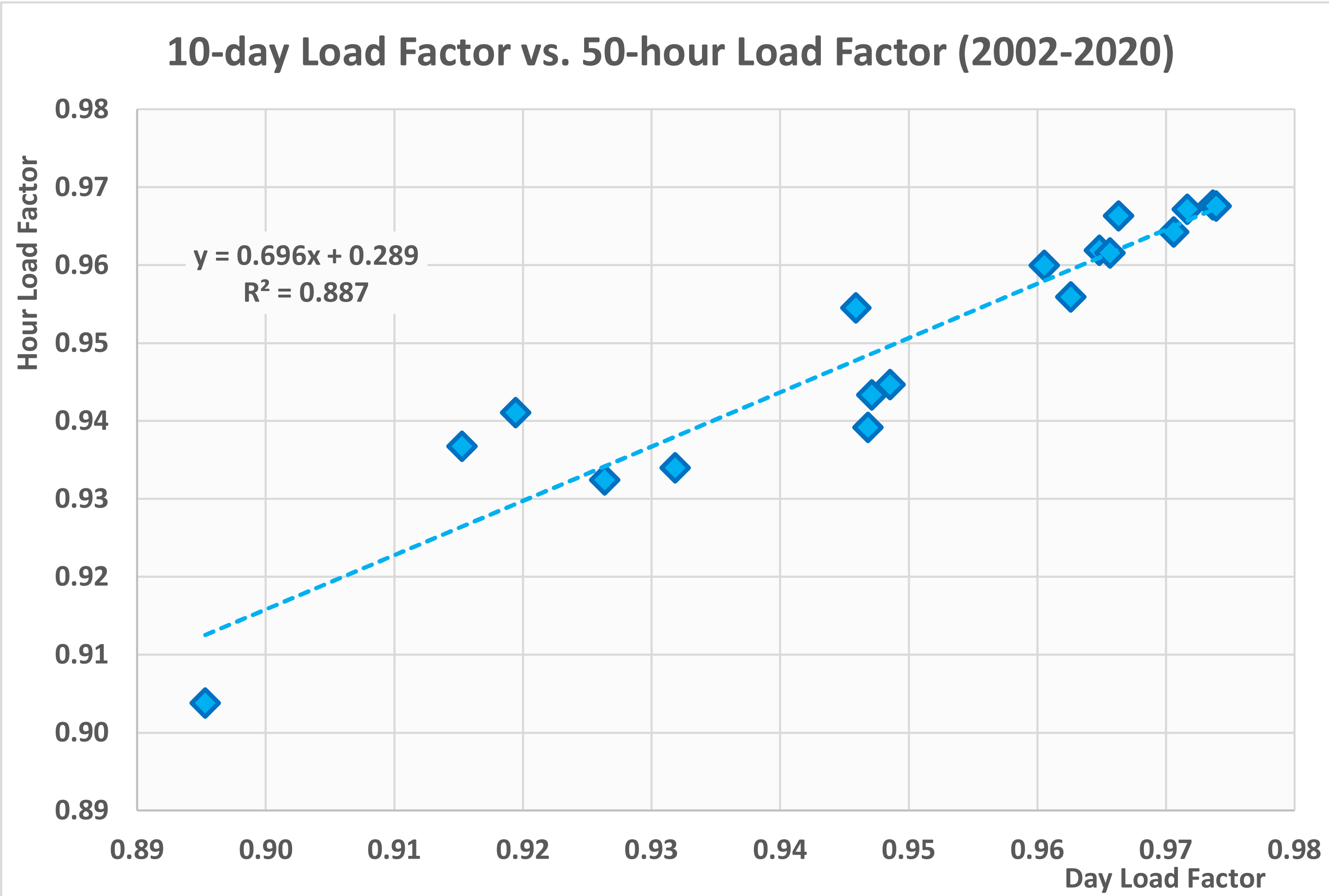

- There is a very strong positive correlation between daily and hourly load duration curve load factors

Annual Load Duration Curve Metrics with Rankings						
Year	Peak Day CTHI	10-day Load Factor	50-hour Load Factor	Rank CTHI	Rank Day Load Factor	Rank Hour Load Factor
2002	83.03	0.974	0.968	11	2	1
2004	81.40	0.963	0.956	16	8	9
2005	82.92	0.974	0.968	13	1	2
2006	87.60	0.915	0.937	2	17	15
2007	82.00	0.965	0.962	15	7	6
2008	84.61	0.926	0.932	6	15	17
2009	82.27	0.946	0.955	14	13	10
2010	86.70	0.932	0.934	3	14	16
2011	87.74	0.895	0.904	1	18	18
2012	83.26	0.947	0.939	10	12	14
2013	86.56	0.919	0.941	4	16	13
2014	80.54	0.961	0.960	17	9	8
2015	82.95	0.966	0.962	12	6	7
2016	83.41	0.949	0.945	9	10	11
2017	80.38	0.972	0.967	18	3	3
2018	84.59	0.971	0.964	7	4	5
2019	84.96	0.966	0.966	5	5	4
2020	83.56	0.947	0.943	8	11	12

- Rankings for the hourly load duration curves are generally similar to the rankings for the daily LDCs
- Hot summers (CTHI above the 70th percentile) are shaded in red; cool summers (CTHI below the 30th percentile) are shaded in blue
- The steepest load duration curves generally correspond to the hottest summers
- A steep load duration curve is most characteristic of load behavior during summers with extreme peak day heat (LFU Bins 1 to 3)

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BTM Solar Adjusted Load Duration Curve Analysis

BTM Solar Adjustment

- The NYISO has developed a time series of estimated actual behind-the-meter (BTM) solar generation for the 2012 through 2020 period
- Pre-2017 estimated actuals are modeled values based on historical Global Horizontal Irradiance (GHI) and solar capacity level data
- 2017 through current year estimated actuals are based on sampled inverter data
- Adjusted historical loads were determined by scaling historical estimated actual BTM Solar data to reach the projected 2022 solar capacity level:

$$Load_{Adjusted} = Load_{Net} + BTM\_Solar_{Y,\,D,H} - BTM\_Solar_{Y,\,D,H} * (BTM\_Capacity_{2022} / BTM\_Capacity_{Y})$$

Where: Y=Year, D=Date, H=Hour; and BTM_Solar is a positive value reflecting estimated actual generation

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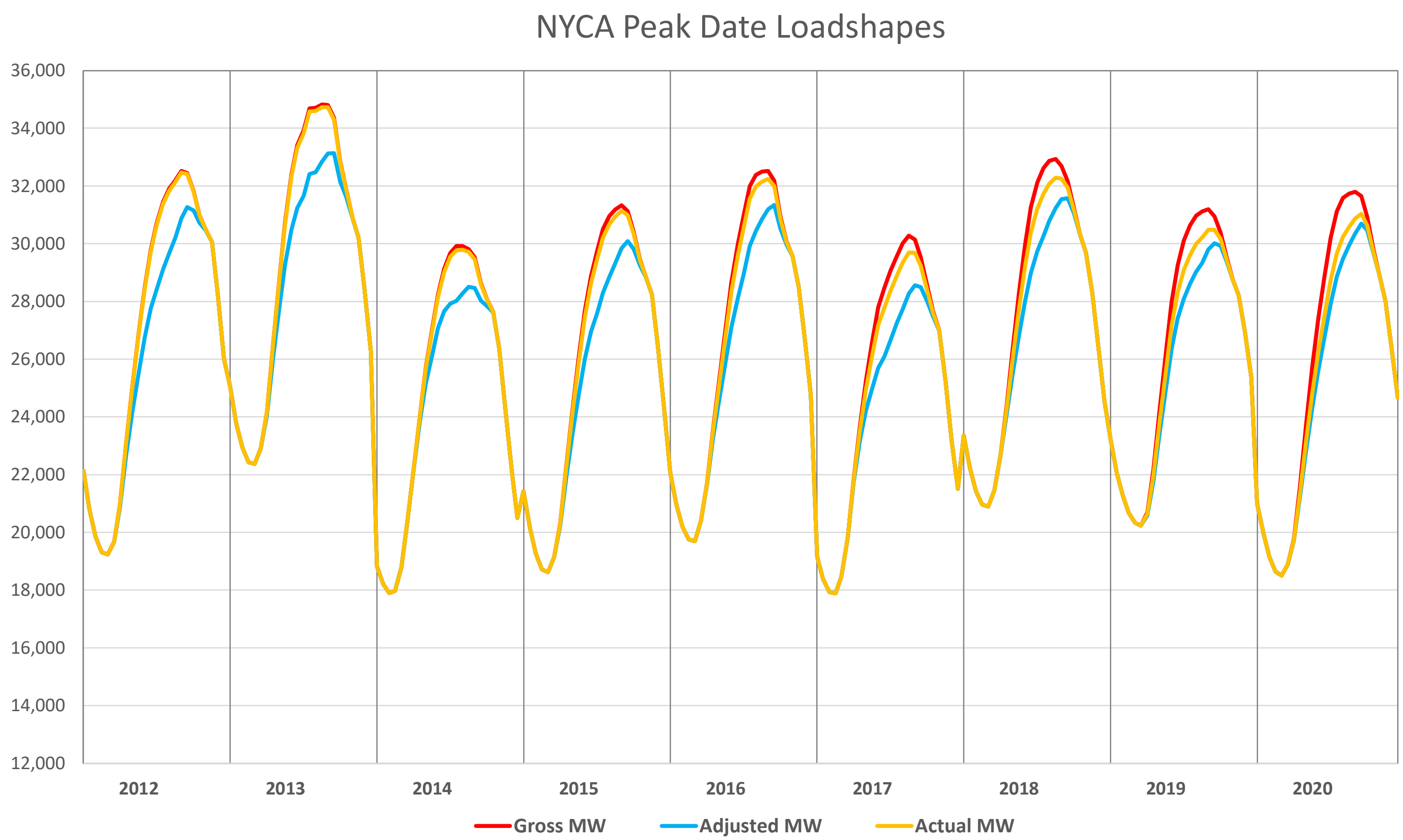

Year	Peak Date
2012	7/17/2012
2013	7/19/2013
2014	9/2/2014
2015	7/29/2015
2016	8/11/2016
2017	7/19/2017
2018	8/29/2018
2019	7/20/2019
2020	7/27/2020

- Actual MW represents metered load.
- Gross MW represents load with all BTM solar impacts added back.
- Adjusted MW represents what the load would have been assuming the projected 2022 BTM solar penetration.
- All load values include estimated NYISO program demand response impacts added back.

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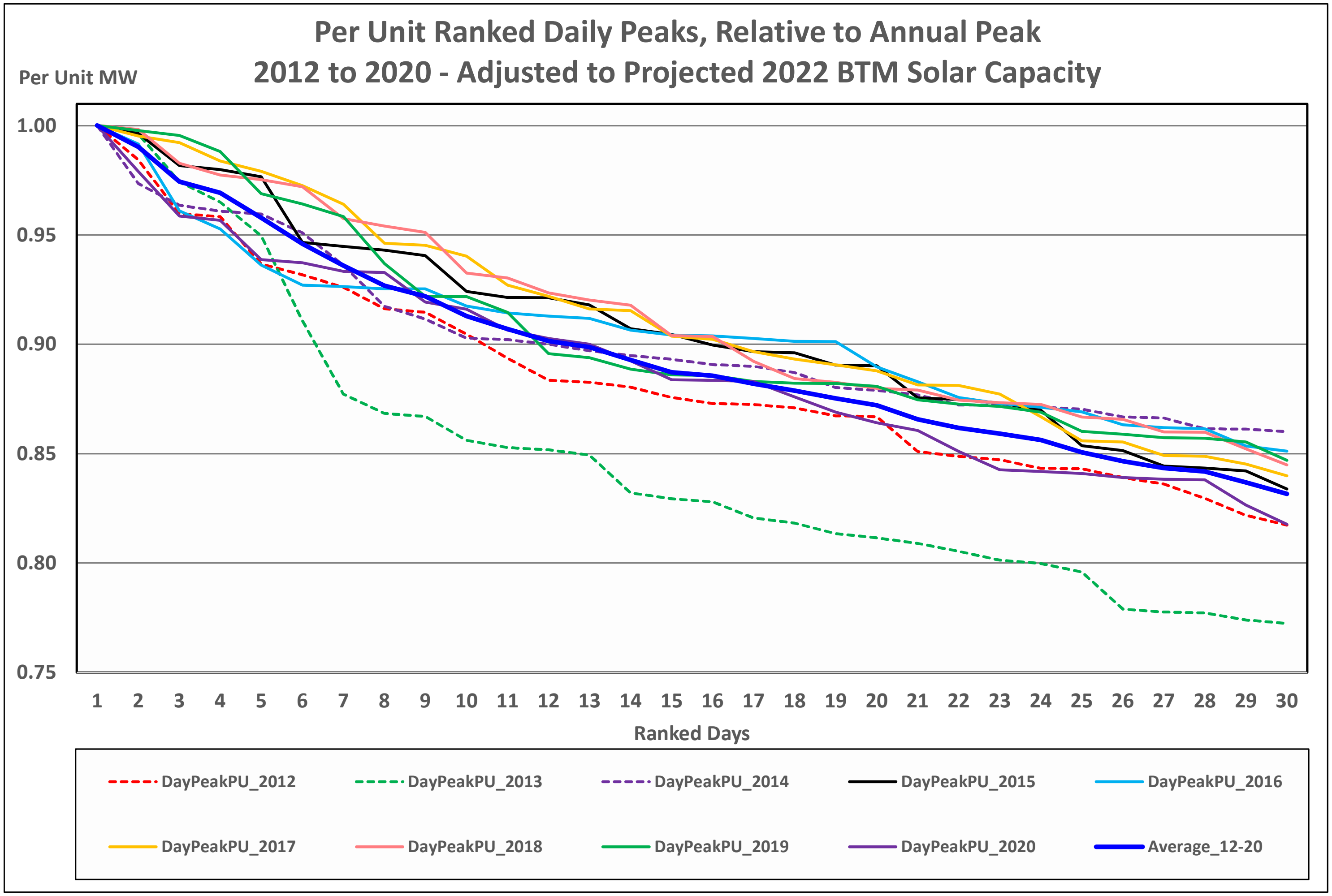

- LDCs adjusted to hit projected 2022 BTM solar capacity level
- Most years are fairly similar to the long-term average
- 2013 has a fairly steep slope beginning on ranked day 6

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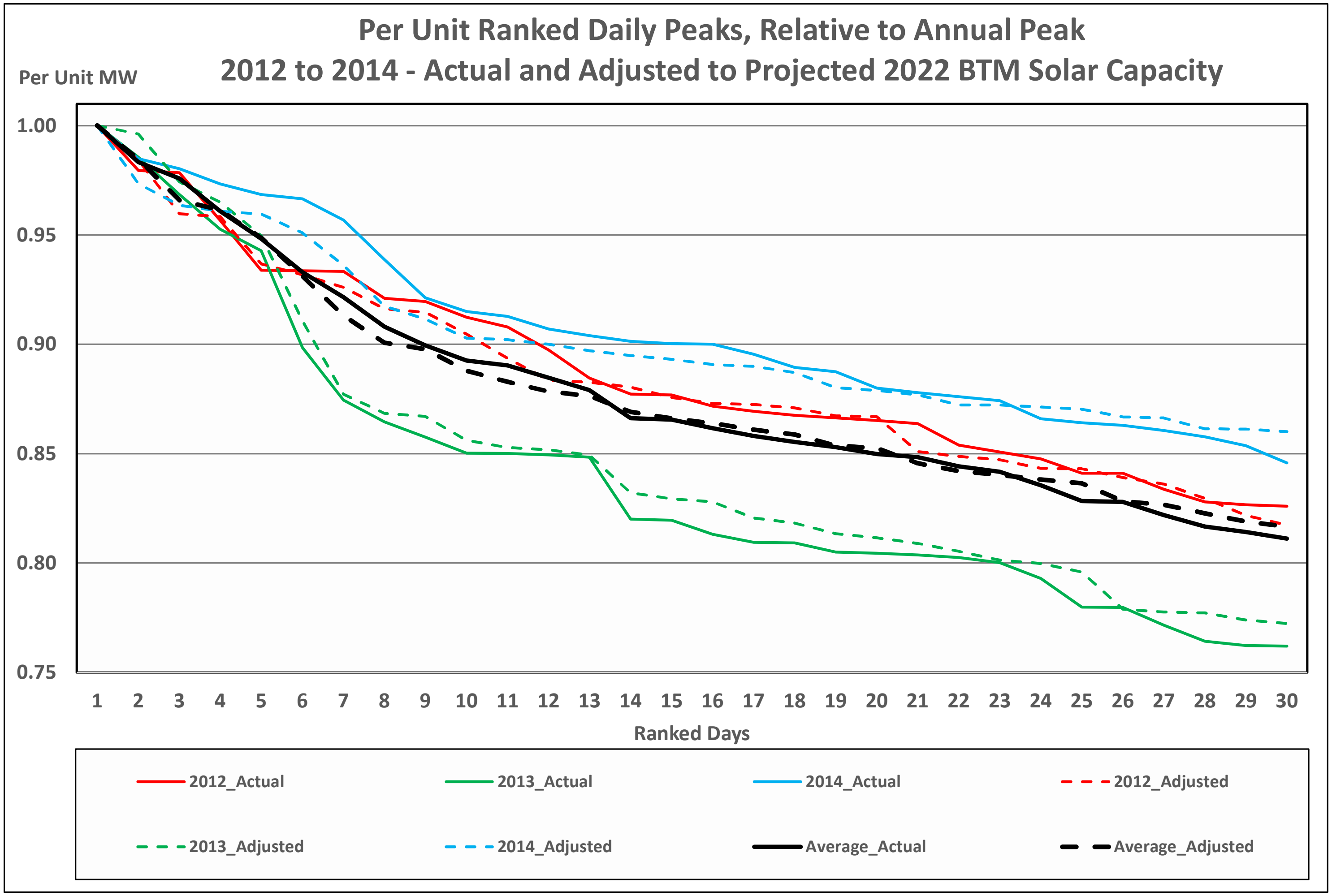

- 2012 and 2014 adjusted LDCs are similar to the actual LDCs, with no persistent deviation
- 2013 adjusted LDC is similar to the actual LDC, however the adjusted is consistently above the actual, yielding a flatter shape
- The average adjusted LDC across this timeframe is very similar to the average actual LDC
- These comparisons were repeated with the 2015 through 2020 LDCs, producing similar results

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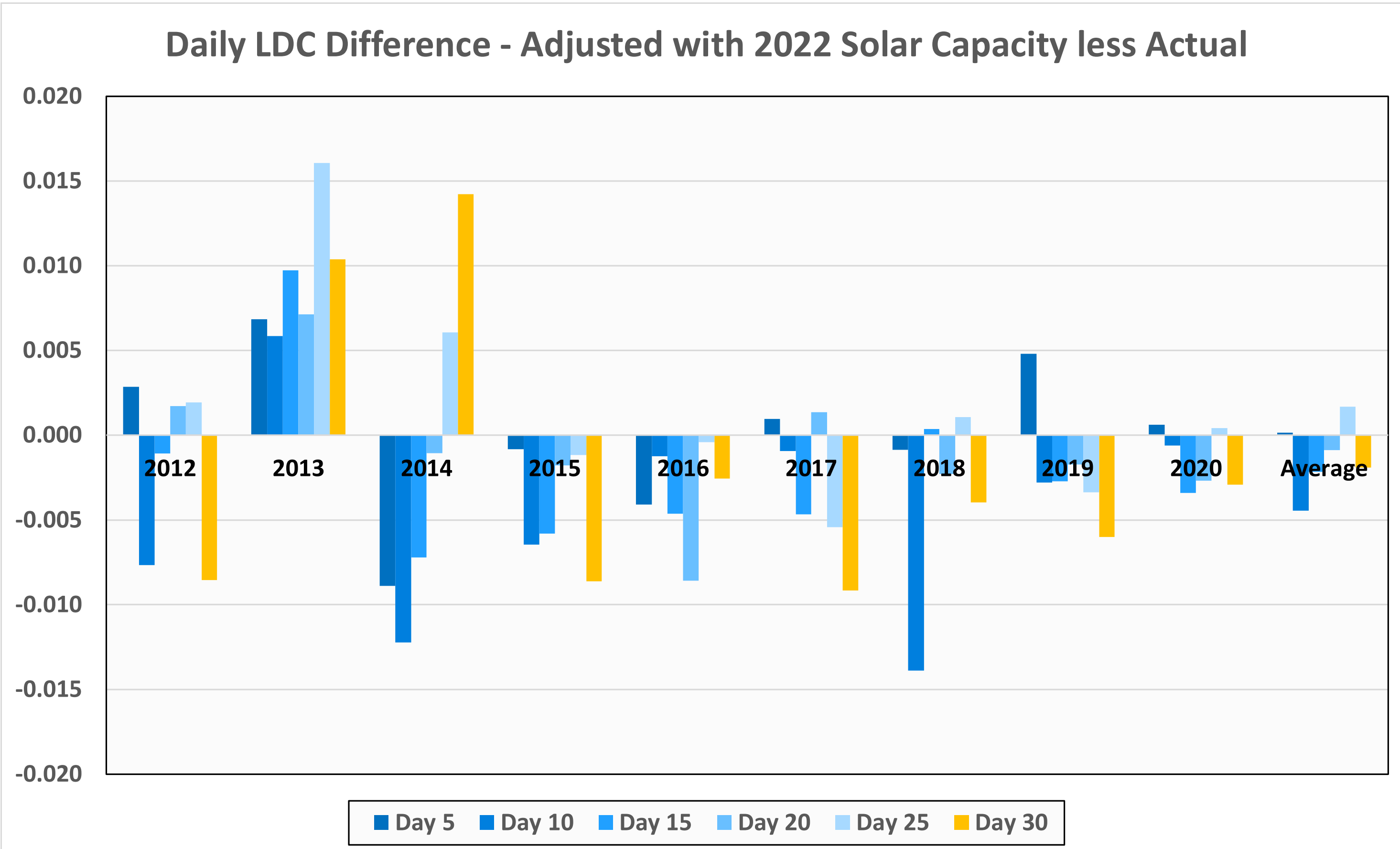
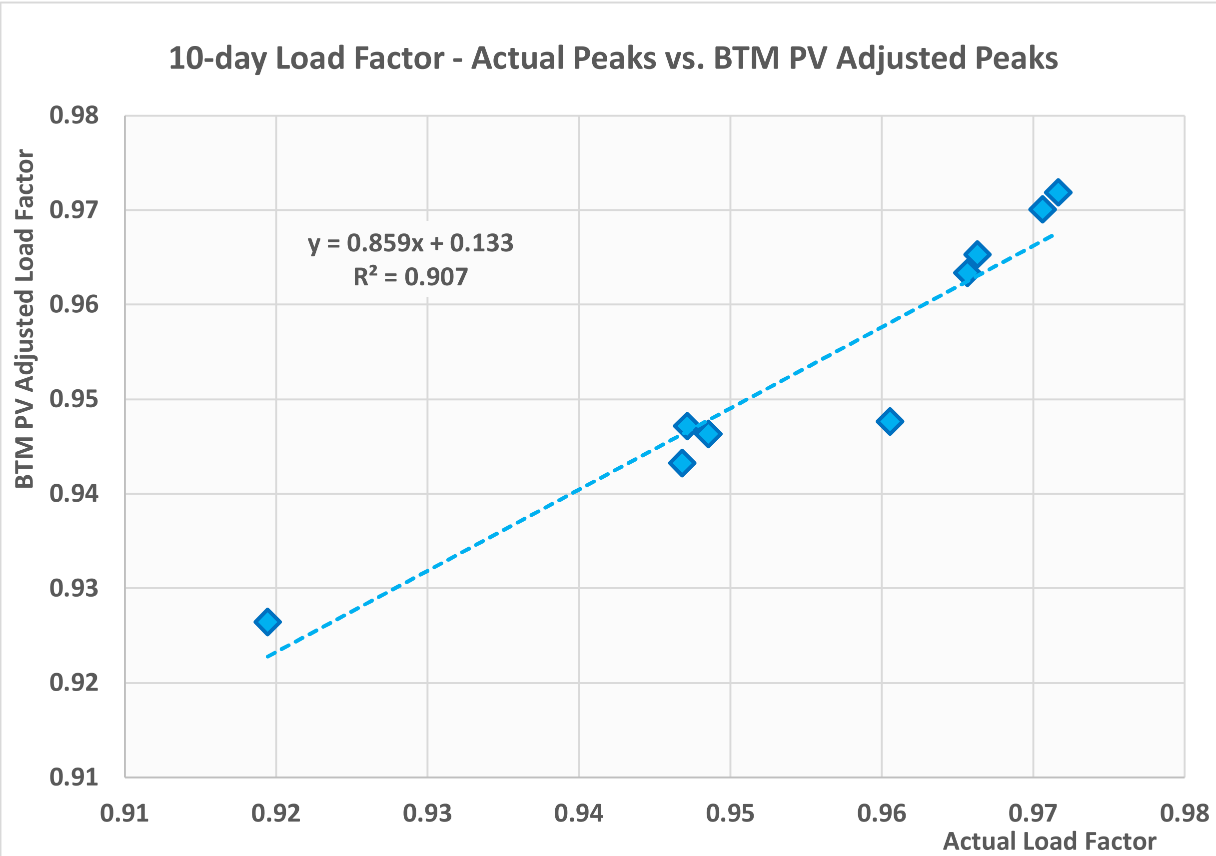


- This graph shows the difference between the adjusted and actual LDCs at various ranked days
- 2013 shows the largest deviation (persistently positive)
- On average the delta is slightly negative, but minimal
- Overall, there is very little difference in the actual and adjusted LDCs



Year	Actual Load Factor	Adjusted* BTM Solar Load Factor
2012	0.947	0.943
2013	0.919	0.926
2014	0.961	0.948
2015	0.966	0.963
2016	0.949	0.946
2017	0.972	0.972
2018	0.971	0.970
2019	0.966	0.965
2020	0.947	0.947

* BTM solar penetration set to projected 2022 levels.

- Actual and adjusted top 10-day load factors are highly correlated, with no apparent systemic bias
- This implies that the behavior of the adjusted LDC closely matches that of the actual LDC in any given year

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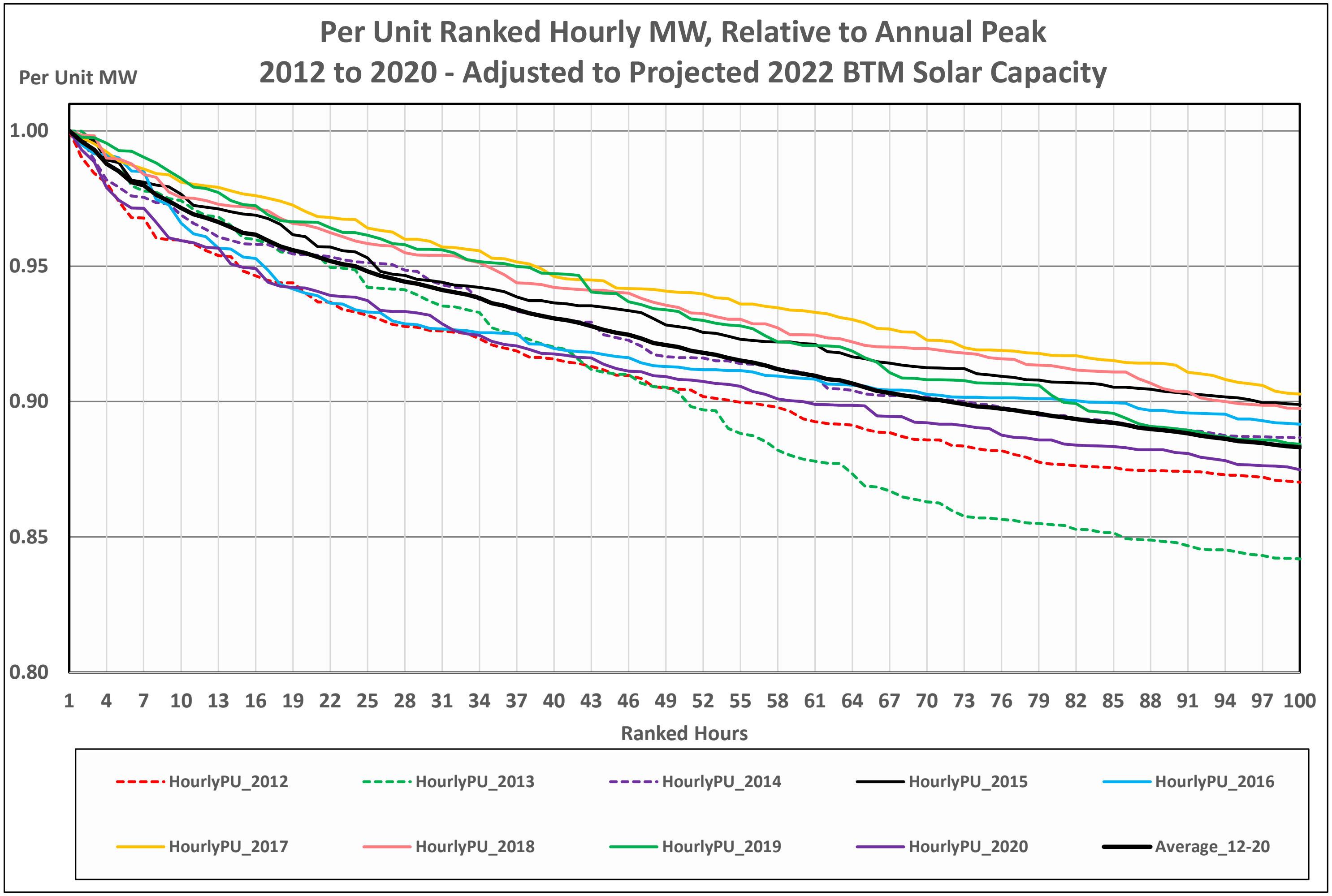

- LDCs adjusted to hit projected 2022 BTM solar capacity level
- Most years are fairly similar to the long-term average
- 2013 values fall significantly below the average in ranked hours 50 to 100

Key Takeaways

- Years with significantly hot peak-producing weather (analogous to Bin 1 to Bin 3 LFU temperatures) have fairly steep load duration curves.

- However, Bin 2 currently uses the 2002 load shape, which has a fairly flat LDC and is not representative of typical load shape behavior for summers with hot peak-producing weather.

- There is a very strong correlation between daily and hourly load duration curve results.

- For 2012 through 2020, differences between the actual LDCs and the BTM-adjusted LDCs are very minimal, and do not show a strong systemic deviation. Thus, solely from a load duration curve perspective, using BTM-adjusted versus actual load duration curves would be unlikely to have significant impacts, especially if recent years are utilized.

- The NYISO does not have BTM Solar estimated actuals prior to 2012, so the potential impacts on the 2002, 2006, and 2007 LDCs have not been quantified. However, given the analysis performed for 2012 through 2020, it stands to reason that the relative behavior of those LDCs would not change significantly.

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Questions?

Our mission, in collaboration with our stakeholders, is to serve the public interest and provide benefit to consumers by:

- Maintaining and enhancing regional reliability
- Operating open, fair and competitive wholesale electricity markets
- Planning the power system for the future
- Providing factual information to policymakers, stakeholders and investors in the power system

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