New York ISO
Independent System Operator

BTM Solar Load Duration Curve Impacts

Max Schuler

Demand Forecasting & Analysis

Load Forecasting Task Force

July 21, 2021, Teleconference

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 is meant to capture the impacts of increasing penetration of behind-the-meter (BTM) Solar between 2012 and 2022, and to identify potential differences in the load duration curves caused by these changes.

New York ISO

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

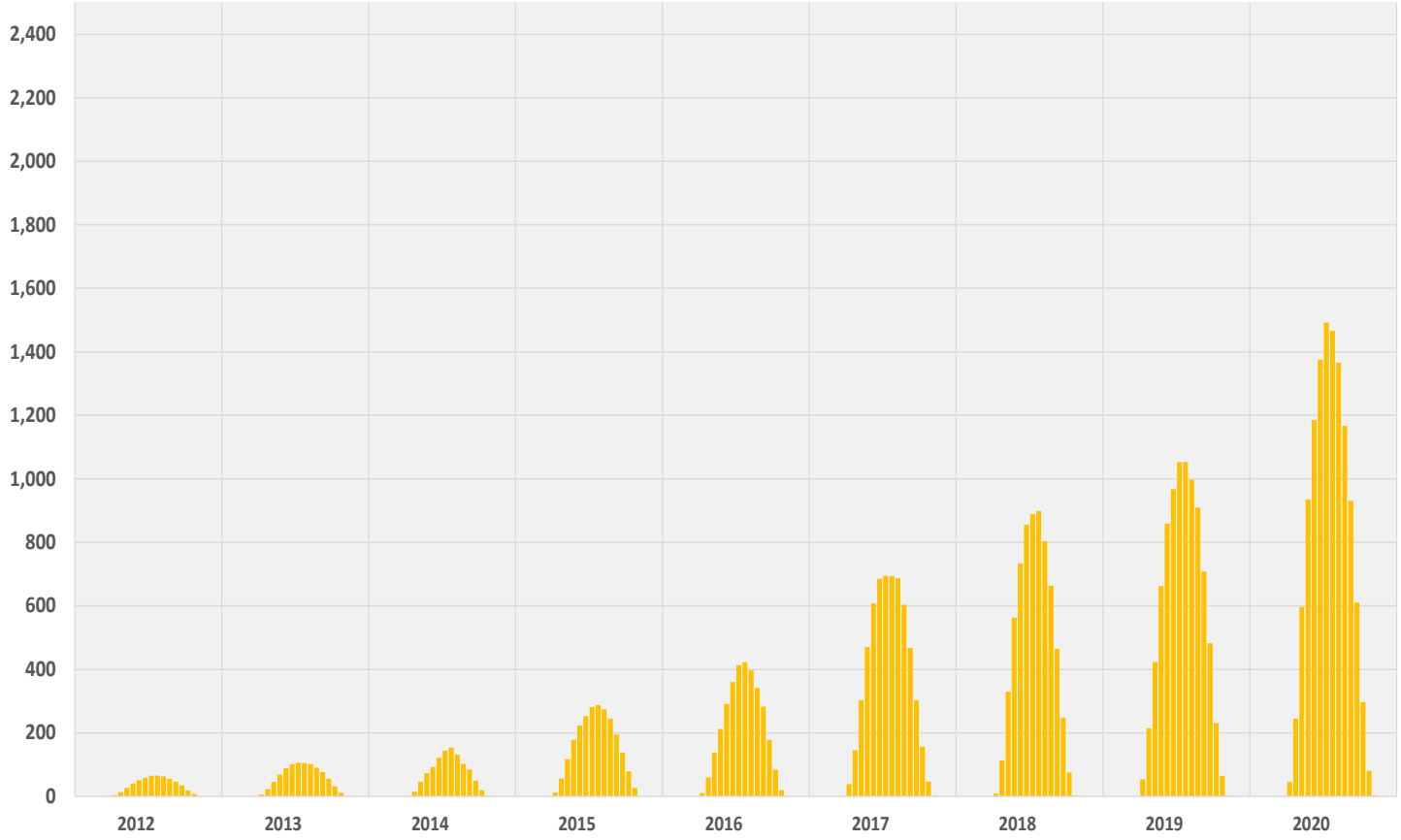
New York ISO

Analysis Methodology

- **Load Duration Curve (LDC) Analysis for the 2012 through 2020 summers was repeated to capture the impacts of behind-the-meter (BTM) Solar**
  - All analysis performed at the system level
  - All load values add back estimated NYISO program demand response impacts
  - 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 load shape comparison
  - Comparison of daily actual vs. adjusted LDCs
  - Comparison of hourly actual vs. adjusted LDCs

New York ISO

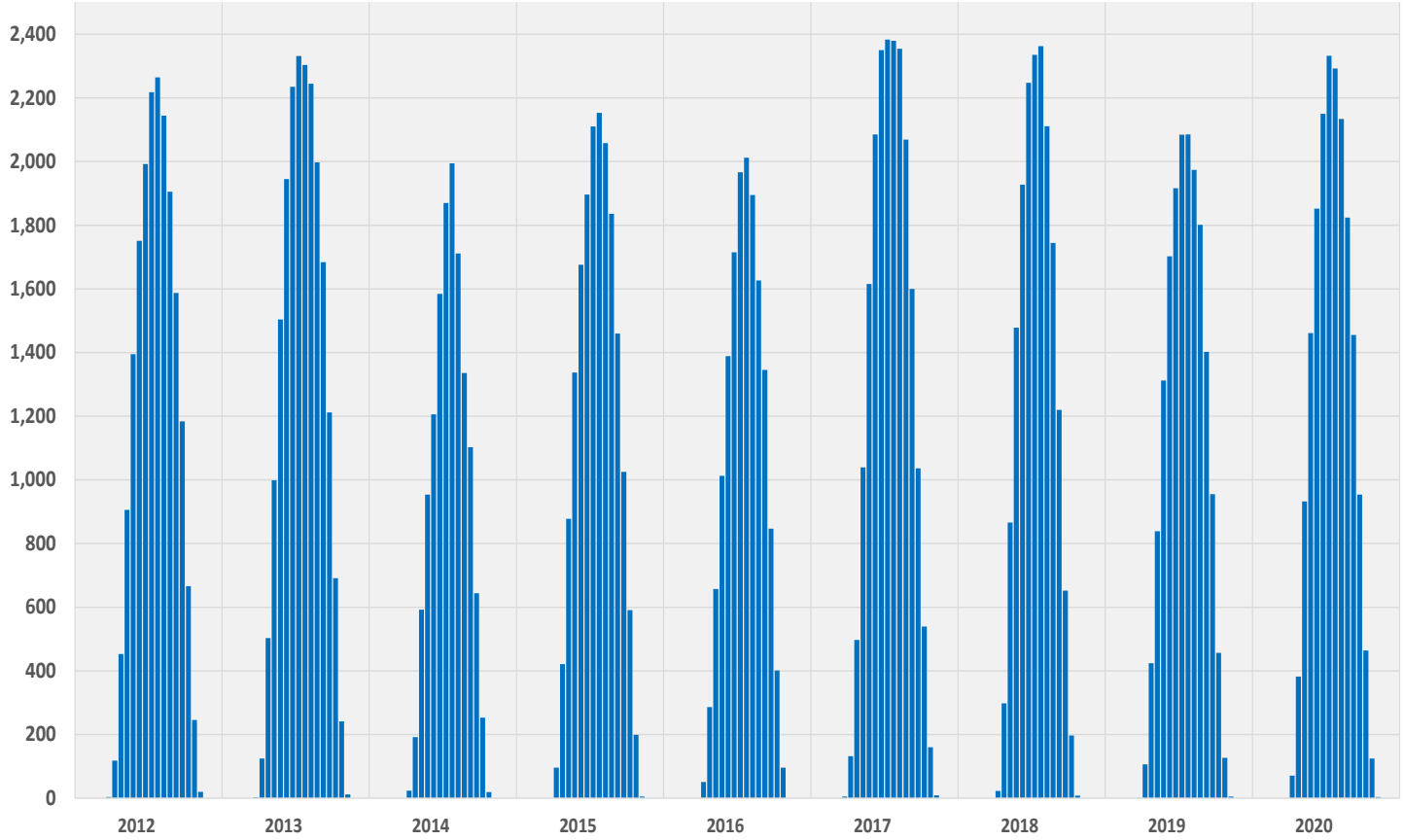
NYCA Estimated Actual Hourly BTM Solar Generation - NYCA Peak Load Dates (MW)



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

New York ISO

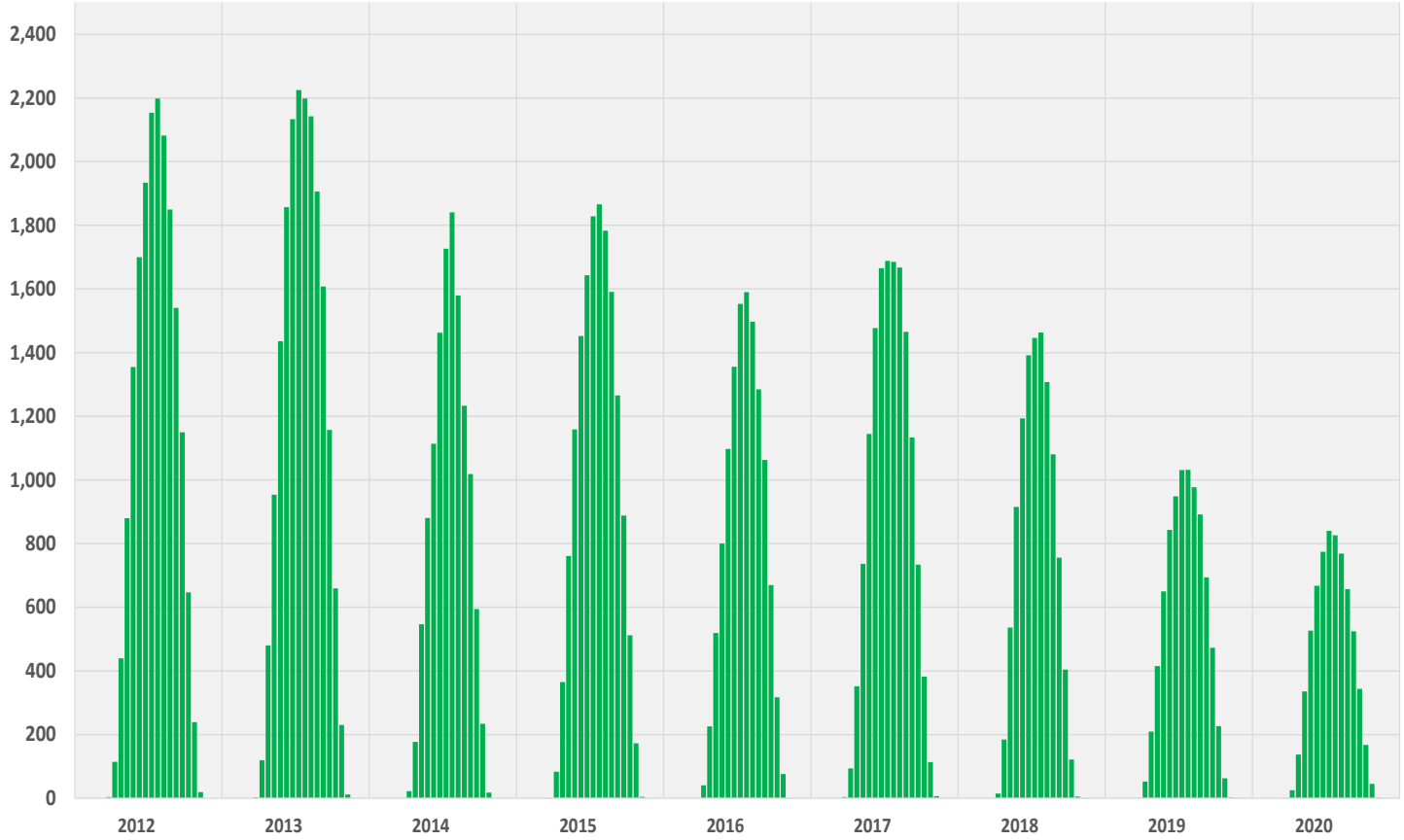
NYCA Estimated Actual Hourly BTM Solar Generation at Projected 2022 Capacity - NYCA Peak Load Dates (MW)



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

New York ISO

NYCA Additional Hourly BTM Solar Generation to reach Projected 2022 Capacity - NYCA Peak Load Dates (MW)



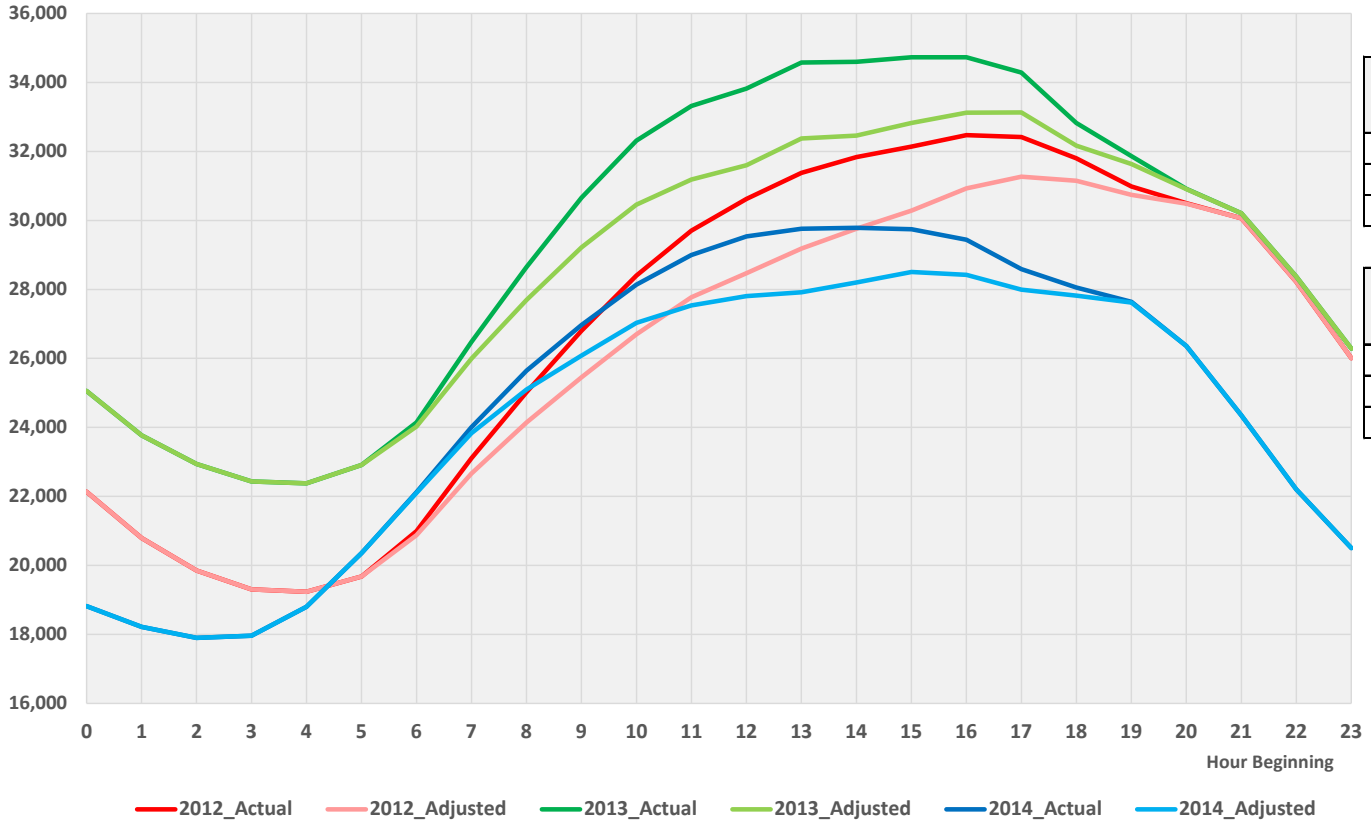
Year	Peak Date
2012	7/17/2012
2013	7/19/2013
2014	9/2/2014
2015	7/29/2015
2016	8/11/2016
2017	7/19/2017
2018	8/29/2018
2019	7/20/2019
2020	7/27/2020

Note: These values represent the additional BTM solar MW above estimated actual needed in order to reach the projected 2022 BTM solar capacity level.

New York ISO

2012 - 2014 NYCA Peak Date Loadshapes - MW

Actual (with DR addback) and Adjusted (with projected 2022 BTM Solar Capacity)



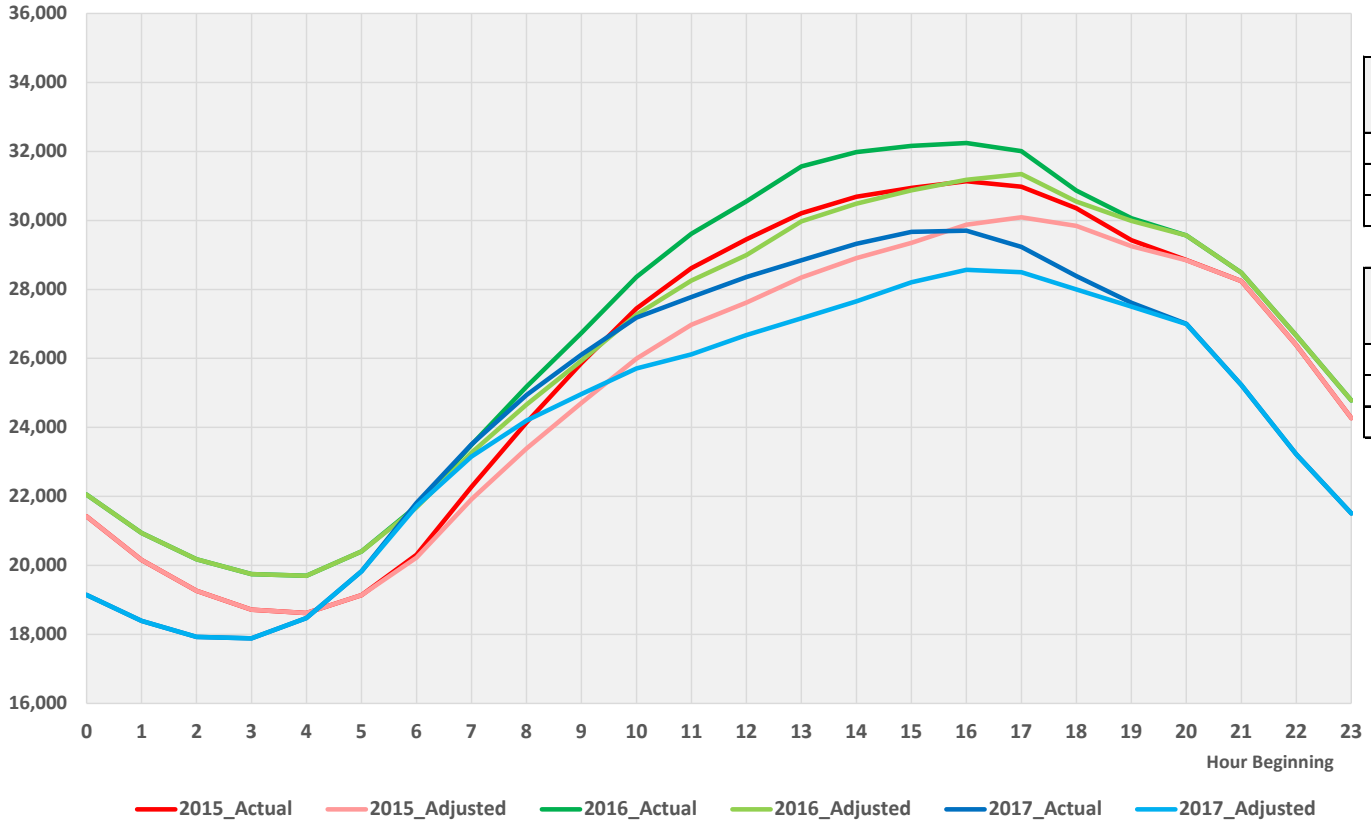
Year	Actual Peak (with DR)	BTM Solar Adjusted Peak	Difference	Percent
2012	32,471	31,265	-1,206	-3.7%
2013	34,729	33,128	-1,601	-4.6%
2014	29,782	28,508	-1,274	-4.3%

Year	Actual Peak Hour	Adjusted Peak Hour
2012	HB 16	HB 17
2013	HB 16	HB 17
2014	HB 14	HB 15

New York ISO

2015 - 2017 NYCA Peak Date Loadshapes - MW

Actual (with DR addback) and Adjusted (with projected 2022 BTM Solar Capacity)



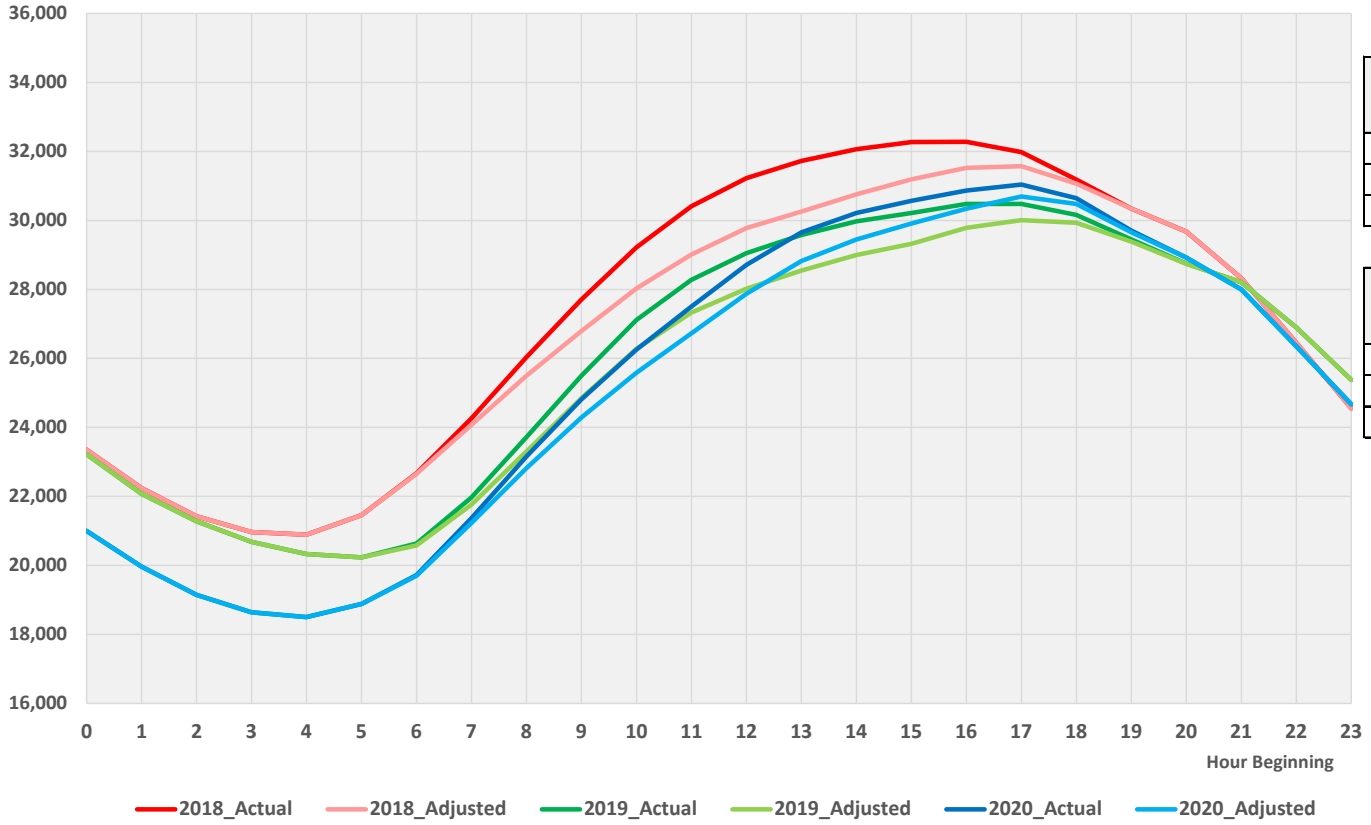
Year	Actual Peak (with DR)	BTM Solar Adjusted Peak	Difference	Percent
2015	31,138	30,087	-1,051	-3.4%
2016	32,243	31,341	-901	-2.8%
2017	29,699	28,566	-1,133	-3.8%

Year	Actual Peak Hour	Adjusted Peak Hour
2015	HB 16	HB 17
2016	HB 16	HB 17
2017	HB 16	HB 16

New York ISO

2018 - 2020 NYCA Peak Date Loadshapes - MW

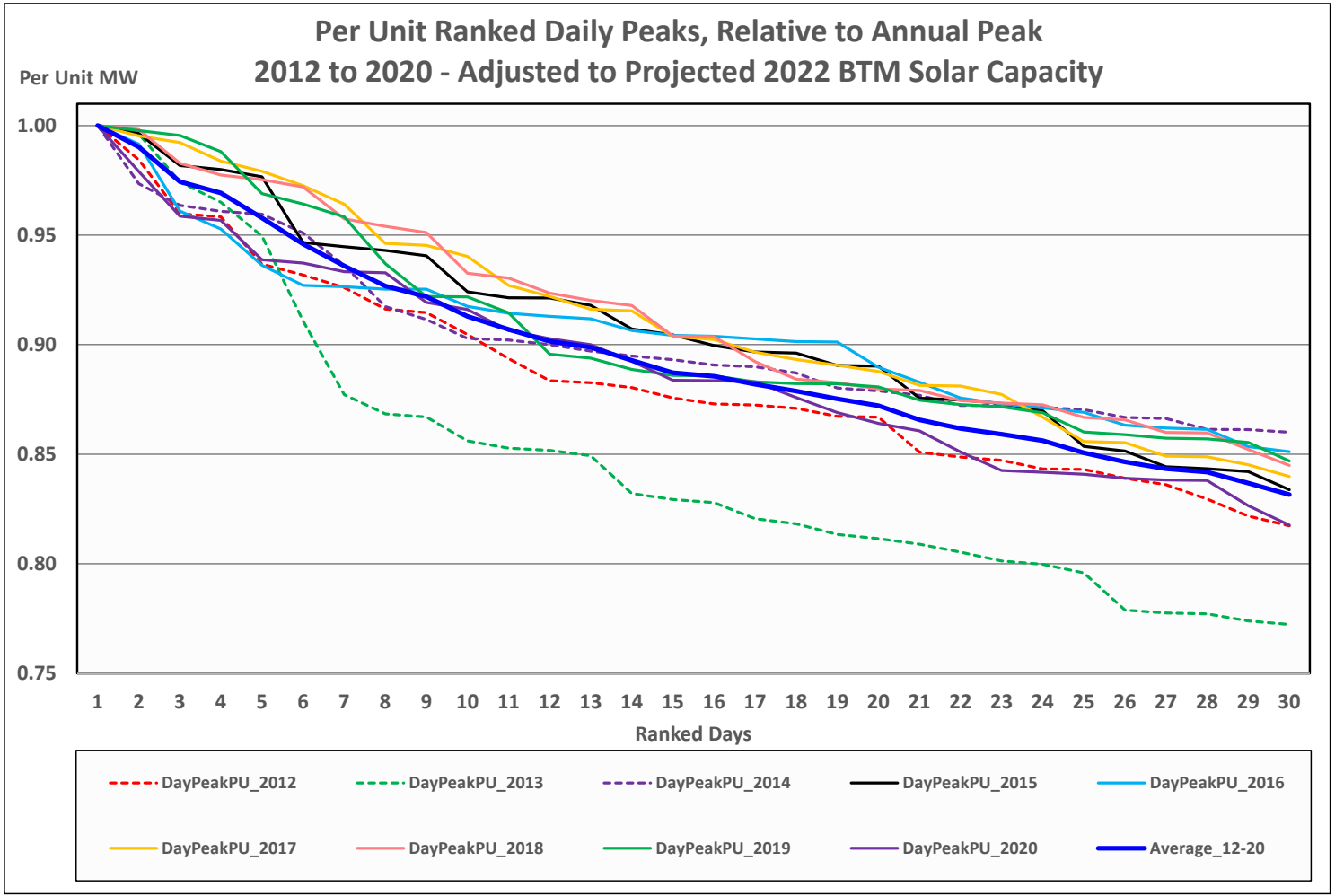
Actual (with DR addback) and Adjusted (with projected 2022 BTM Solar Capacity)



Year	Actual Peak (with DR)	BTM Solar Adjusted Peak	Difference	Percent
2018	32,280	31,573	-707	-2.2%
2019	30,480	30,007	-473	-1.6%
2020	31,037	30,693	-344	-1.1%

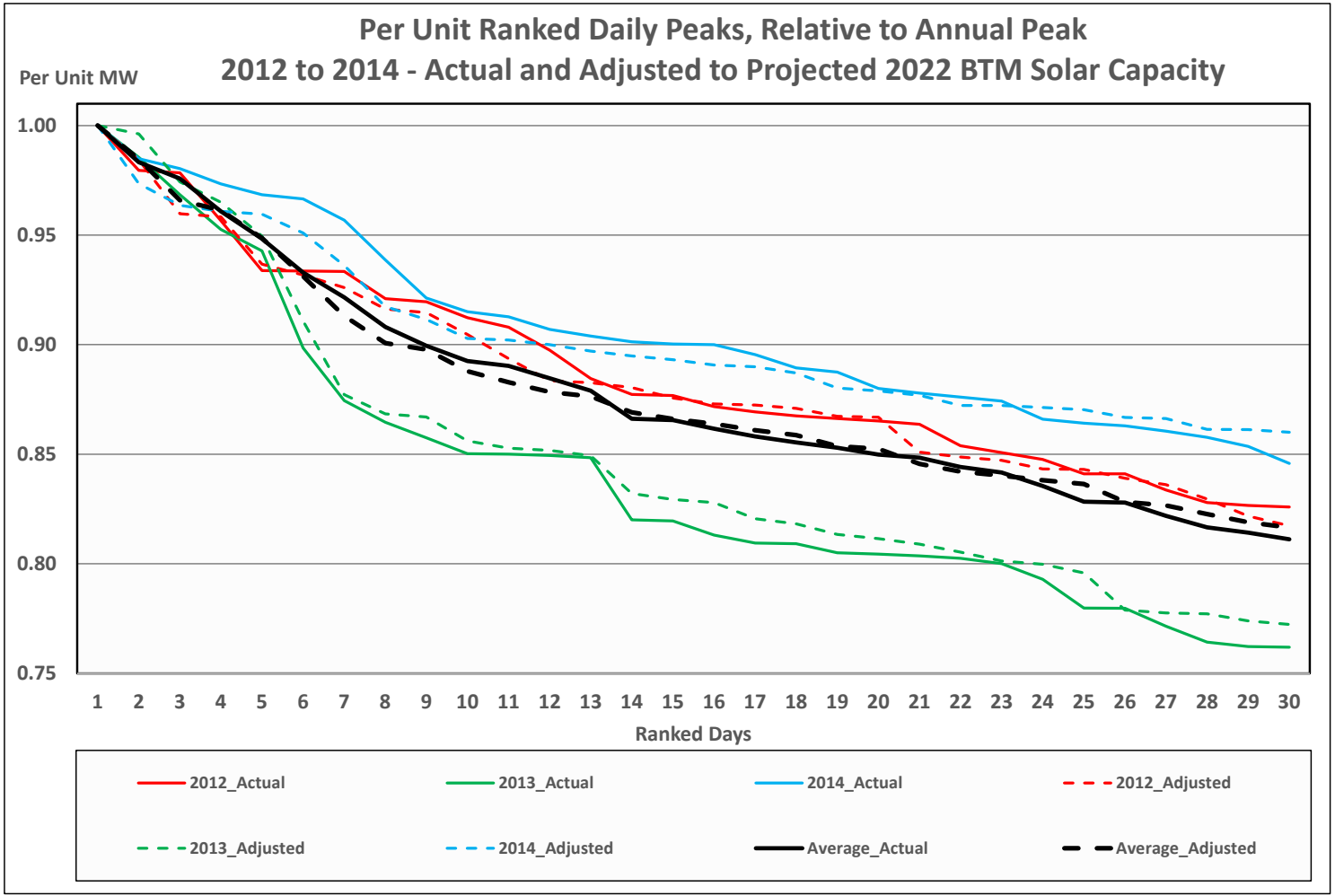
Year	Actual Peak Hour	Adjusted Peak Hour
2018	HB 16	HB 17
2019	HB 16	HB 17
2020	HB 17	HB 17

New York ISO



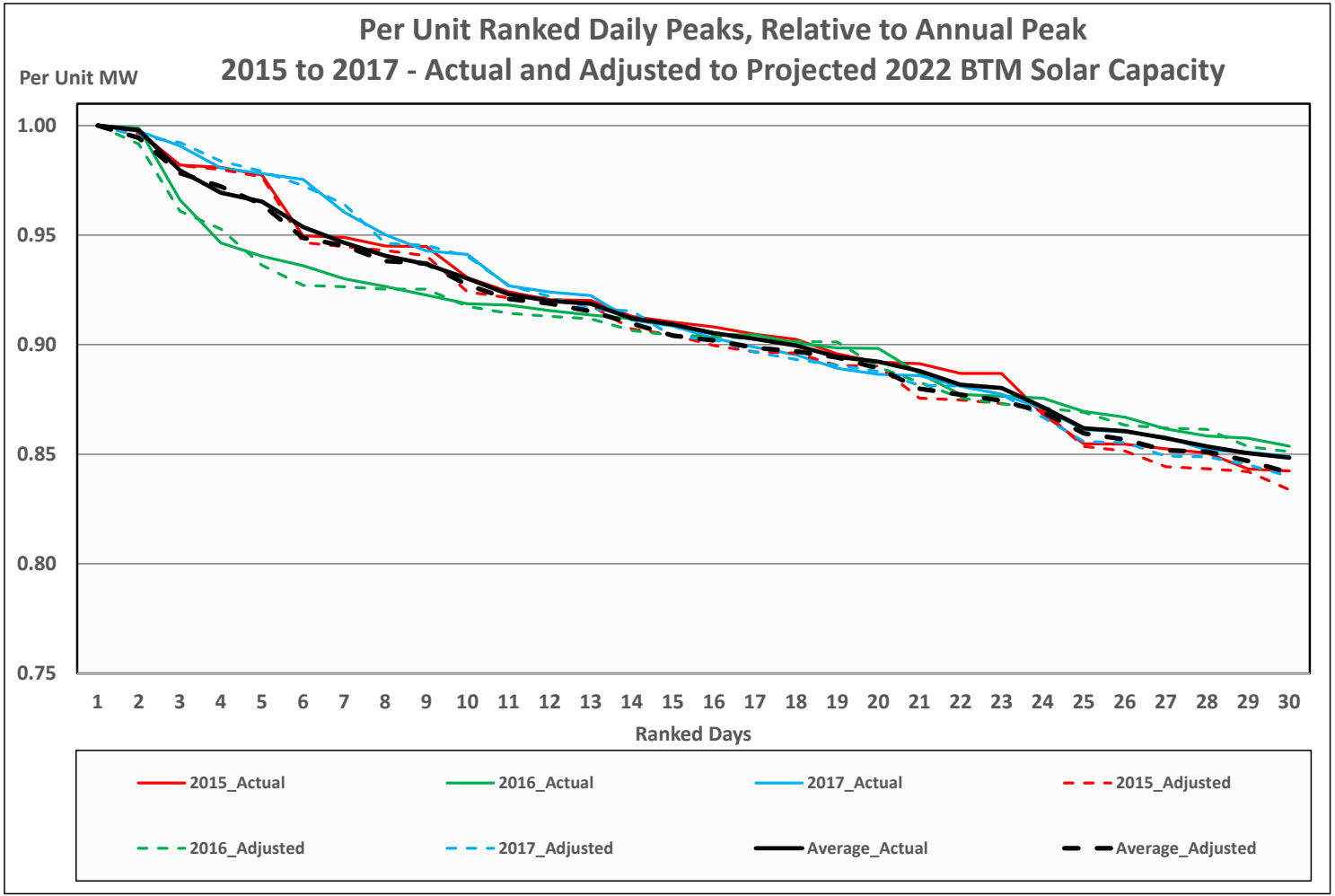
- LDCs adjusted to hit projected 2022 BTM solar capacity level
- Most years are fairly similar to the long-term average
- 2013 is an outlier with a very steep shape

New York ISO



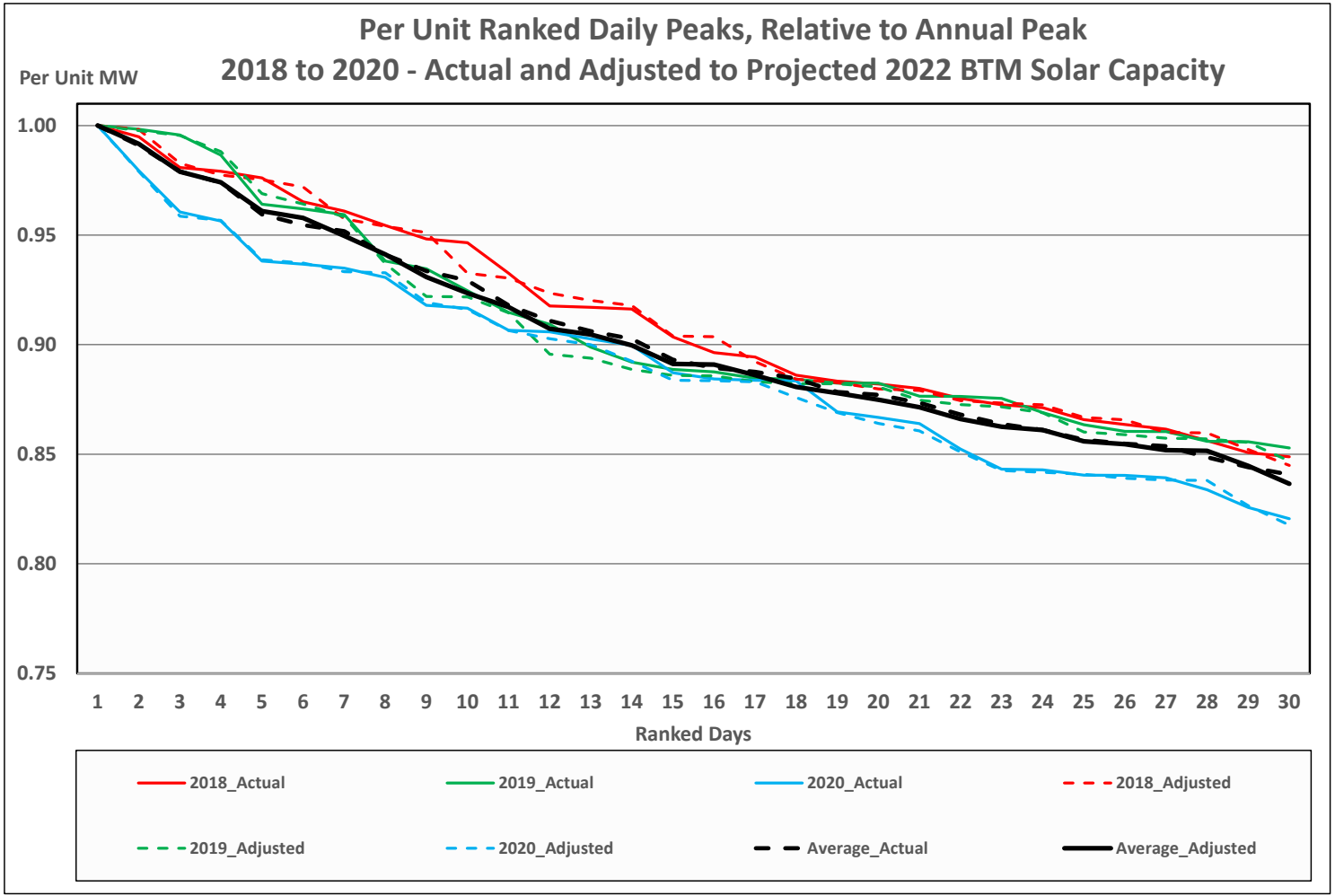
- 2012 and 2014 adjusted LDCs are similar to the actual LDCs, with no persistent deviation
- 2013 adjusted LDC is similar to the actual LDC, however the adjusted is consistently above the actual, yielding a flatter shape
- The average adjusted LDC across this timeframe is very similar to the average actual LDC

New York ISO



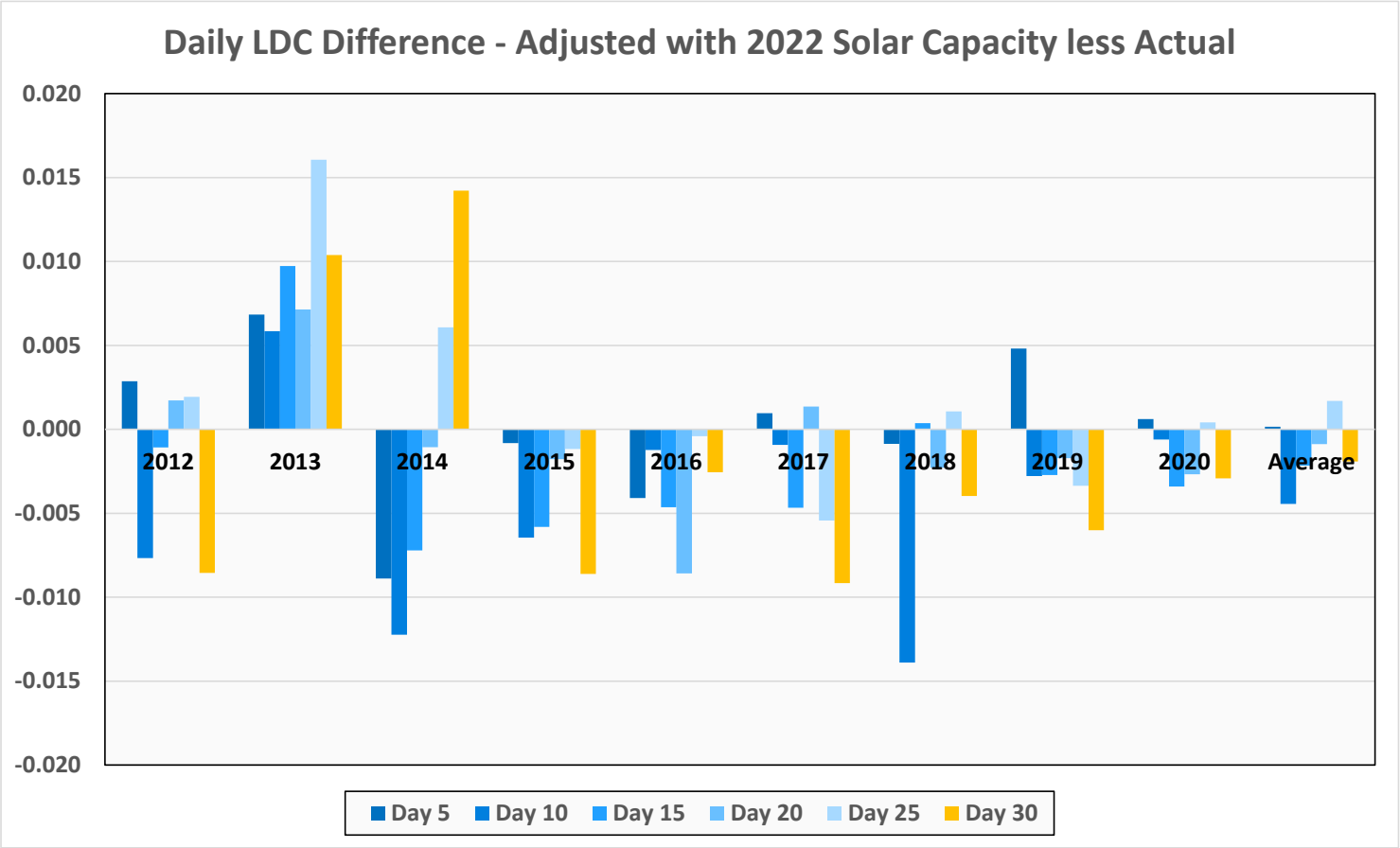
- 2015, 2016, and 2017 adjusted LDCs are similar to the actual LDCs, with no persistent deviation
- The average adjusted LDC across this timeframe is very similar to the average actual LDC

New York ISO



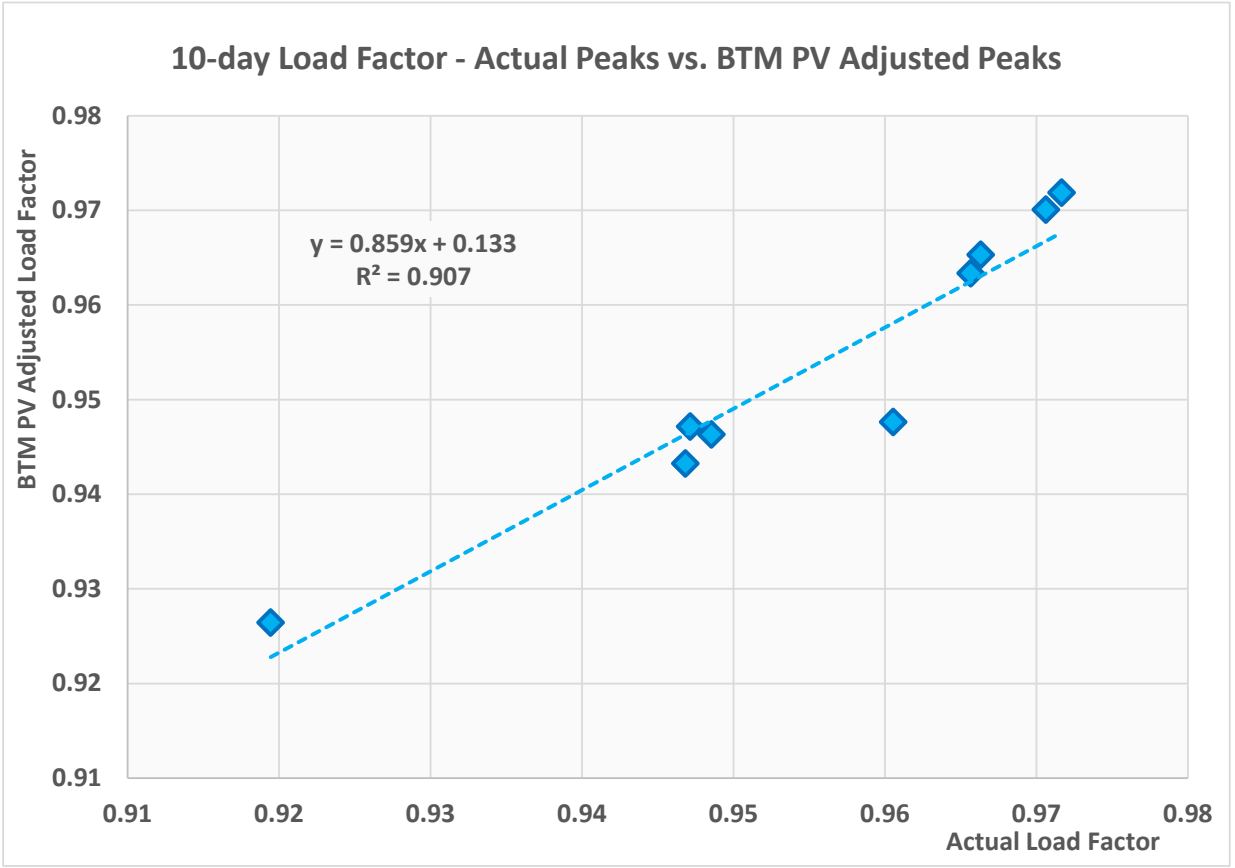
- 2018, 2019, and 2020 adjusted LDCs are similar to the actual LDCs, with no persistent deviation
- The average adjusted LDC across this timeframe is very similar to the average actual LDC

New York ISO



- 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

New York ISO

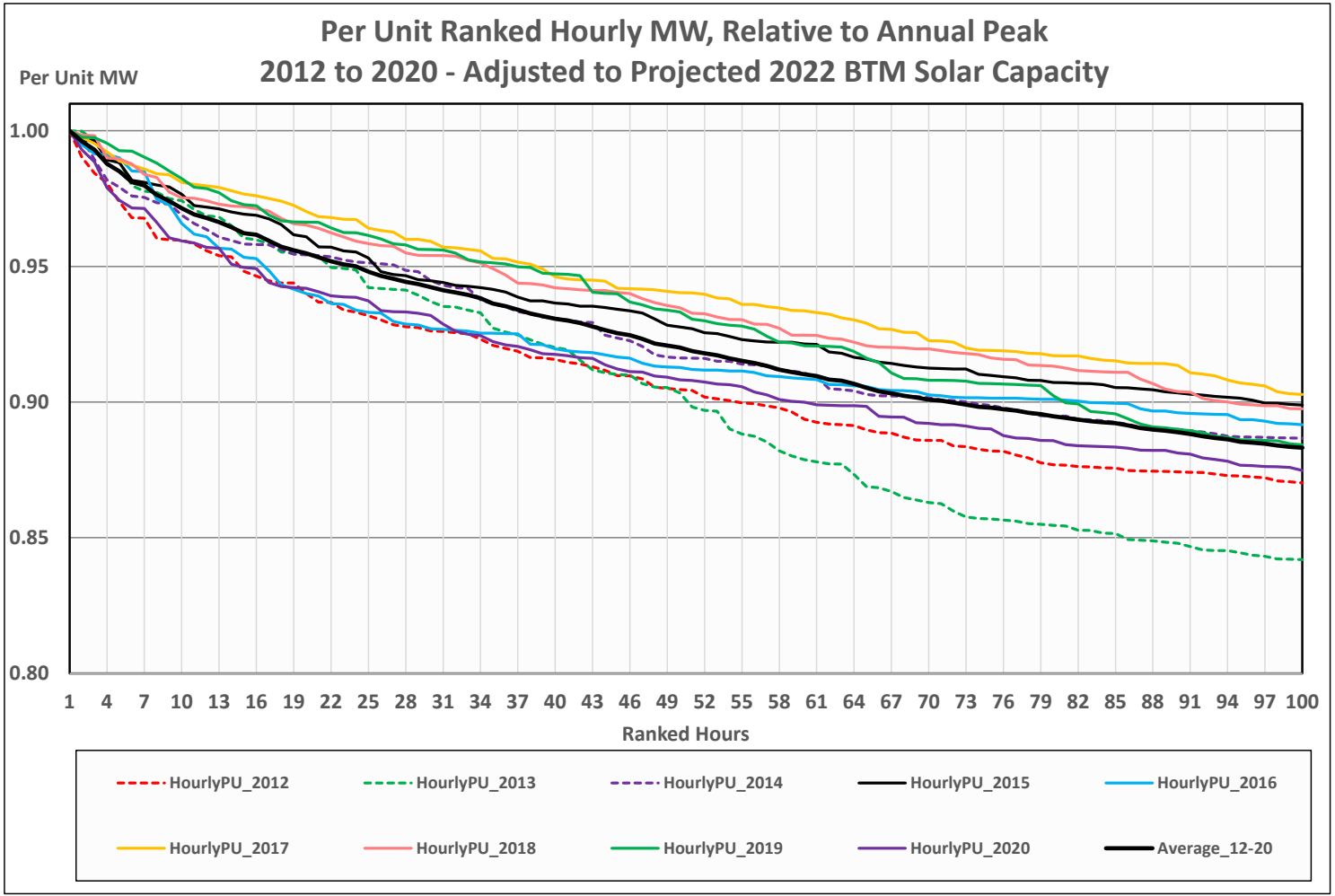


Year	Actual Load Factor	Adjusted* BTM Solar Load Factor
2012	0.947	0.943
2013	0.919	0.926
2014	0.961	0.948
2015	0.966	0.963
2016	0.949	0.946
2017	0.972	0.972
2018	0.971	0.970
2019	0.966	0.965
2020	0.947	0.947

* BTM solar penetration set to projected 2022 levels.

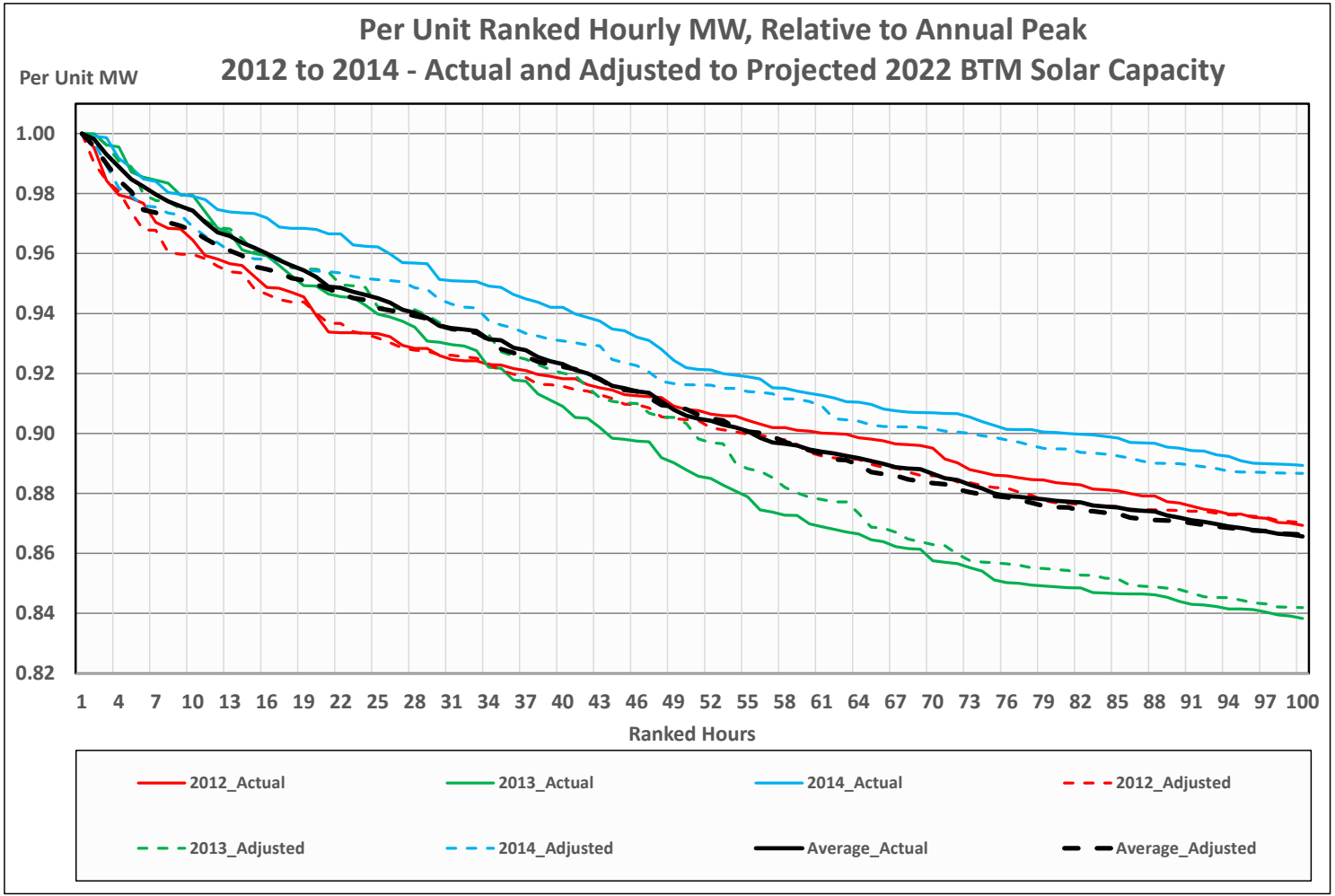
- Actual and adjusted top 10-day load factors are highly correlated, with no apparent systemic bias
- This implies that the behavior of the adjusted LDC closely matches that of the actual LDC in any given year

New York ISO



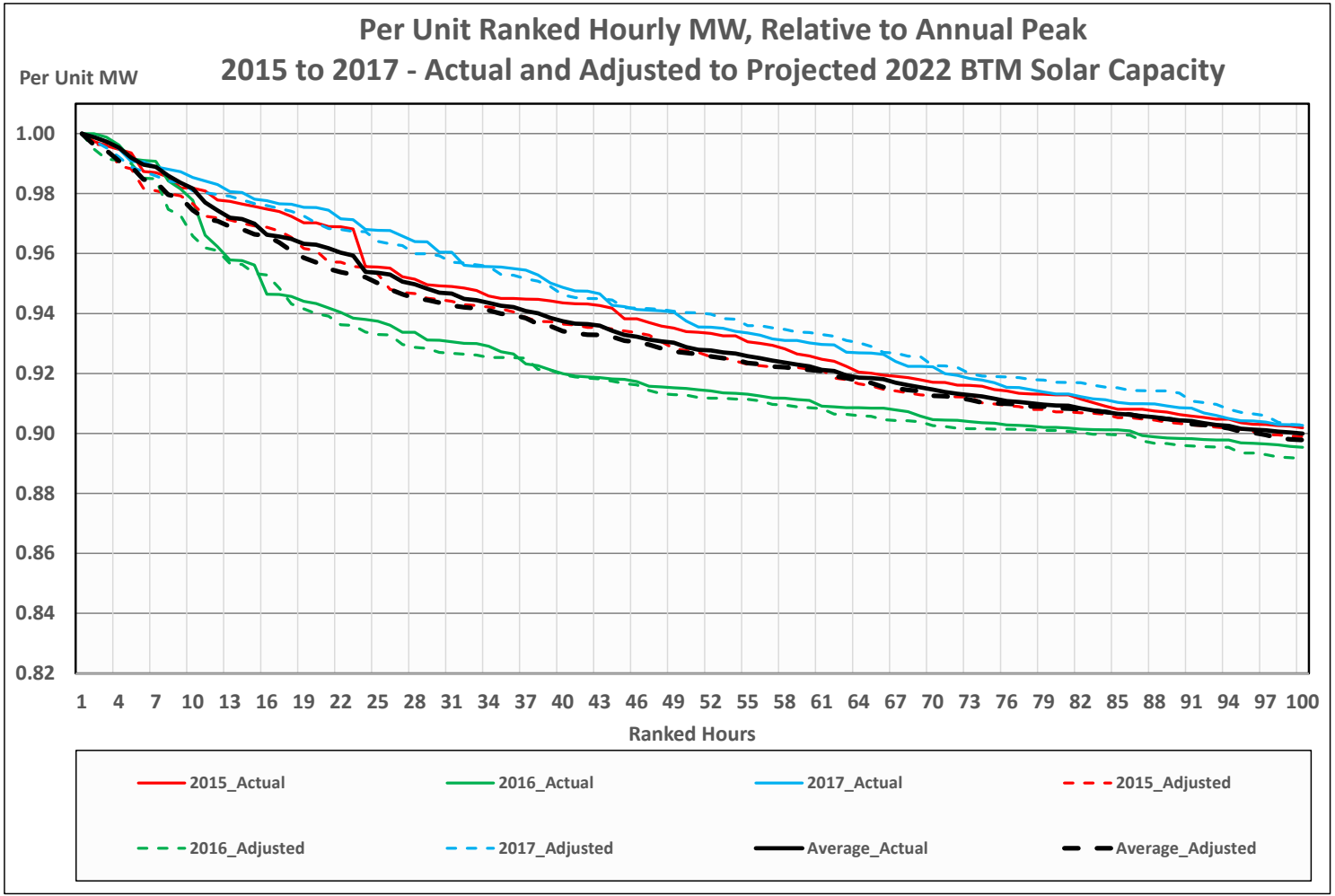
- LDCs adjusted to hit projected 2022 BTM solar capacity level
- Most years are fairly similar to the long-term average
- 2013 values fall significantly below the average in ranked hours 50 to 100

New York ISO



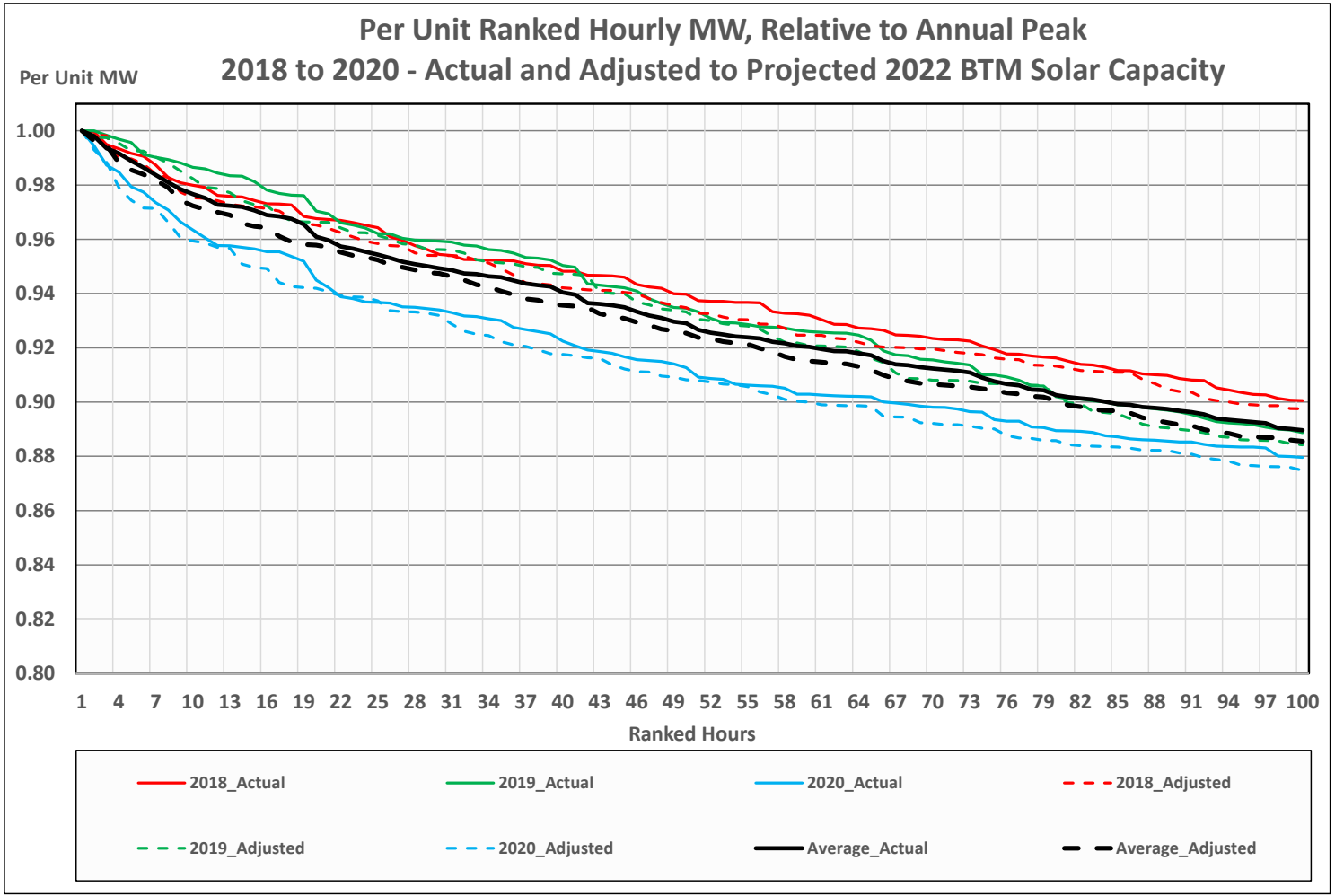
- 2012 adjusted LDC is similar to the actual LDCs, with no persistent deviation
- 2013 adjusted LDC is similar to the actual LDC, however the adjusted is consistently above the actual, yielding a flatter shape
- 2014 adjusted LDC is similar to the actual LDC, however the adjusted is consistently below the actual, yielding a steeper shape
- The average adjusted LDC across this timeframe is very similar to the average actual LDC

New York ISO



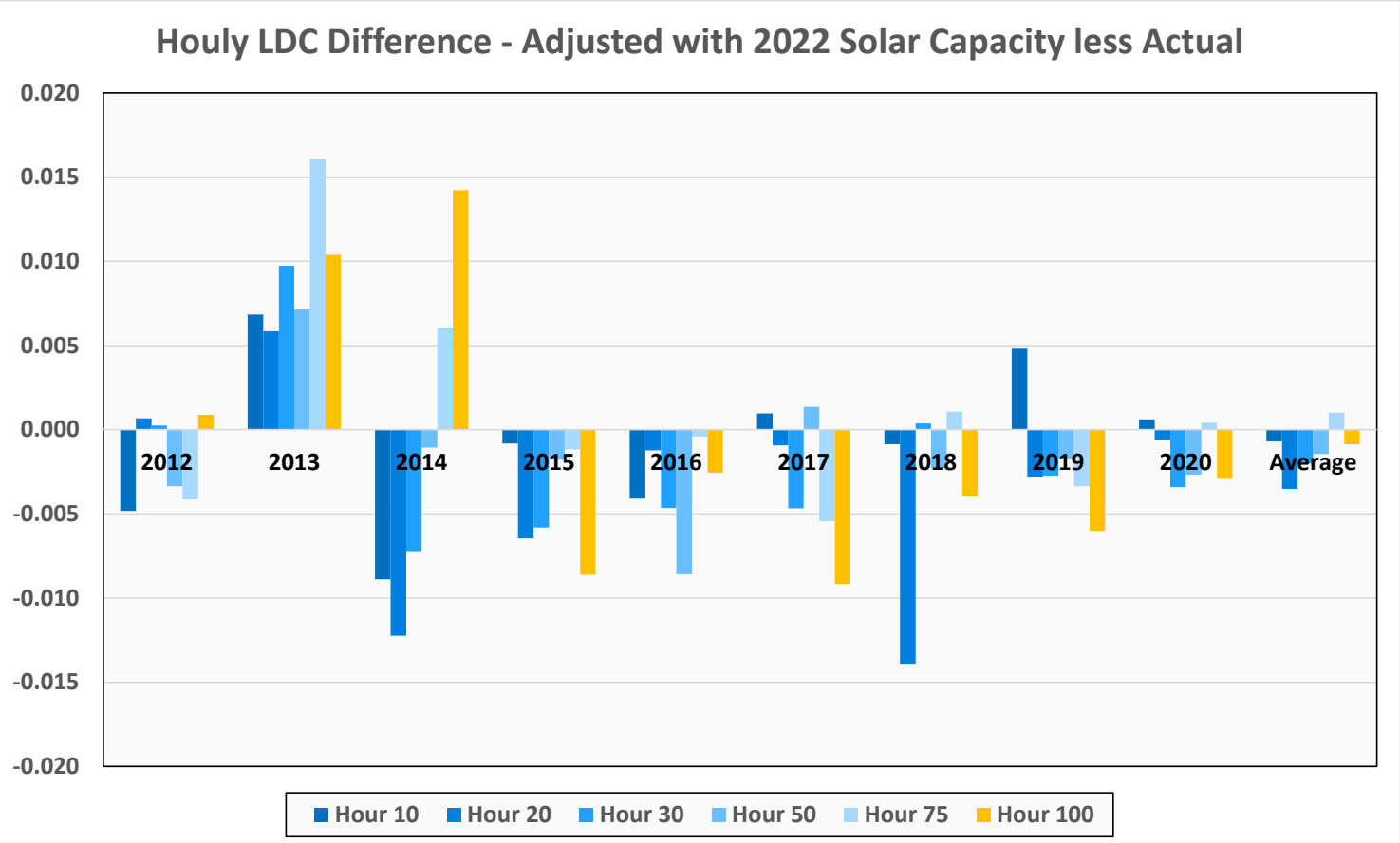
- 2015 and 2016 adjusted LDCs are similar to the actual LDCs, however the adjusted values are consistently below the actual values, yielding steeper shapes
- 2017 adjusted LDC is similar to the actual LDCs, with no persistent deviation
- The average adjusted LDC across this timeframe is very similar to the average actual LDC, but slightly lower

New York ISO



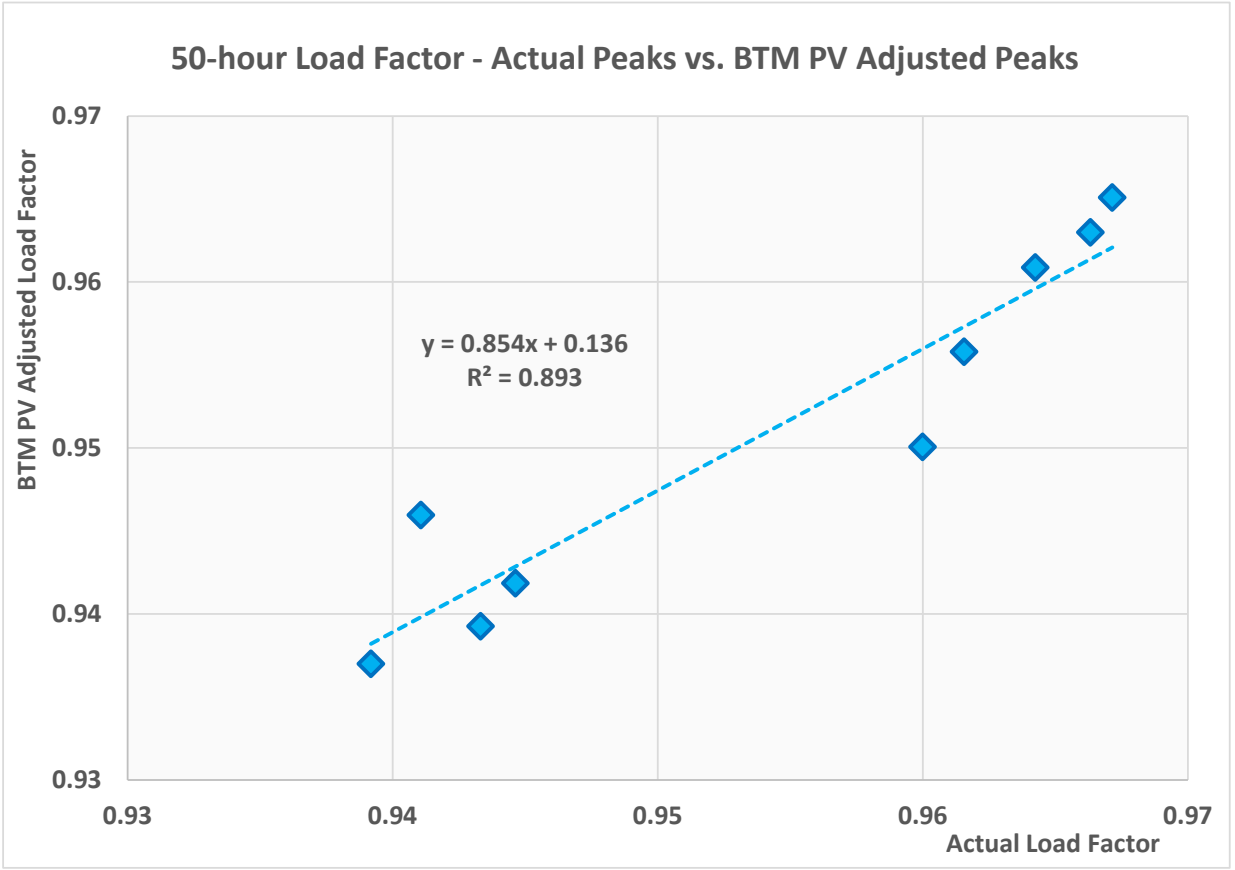
- 2018, 2019, and 2020 adjusted LDCs are similar to the actual LDCs; however the adjusted LDCs tend to be lower than the actual LDCs, yielding steeper curves
- The average adjusted LDC across this timeframe is very similar to and steeper than the average actual LDC

New York ISO



- This graph shows the difference between the adjusted and actual LDCs at various ranked hours
- 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

New York ISO



Year	Actual Load Factor	Adjusted* BTM Solar Load Factor
2012	0.939	0.937
2013	0.941	0.946
2014	0.960	0.950
2015	0.962	0.956
2016	0.945	0.942
2017	0.967	0.965
2018	0.964	0.961
2019	0.966	0.963
2020	0.943	0.939
* BTM solar penetration set to projected 2022 levels.		

- Actual and adjusted top 50-hour 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

New York ISO

Key Takeaways

- Applying the projected 2022 BTM solar capacity level to past NYCA peak days shows that the daily load shape on the peak day would have been noticeably different in past years under a higher solar penetration.

- The adjusted historical peaks shift later into the afternoon, typically occurring during Hour Beginning 17
  - The adjusted peak shifted one hour later during six of the nine historical peak days
  - Seven of the nine adjusted peak day load shapes peaked during the 5 PM hour

- 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

- The NYISO does not have estimated actuals prior to 2012, so the potential impacts on the 2002, 2006, and 2007 LDCs have not been quantified

- 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

New York ISO

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

New York ISO