VIII. Technical Appendices

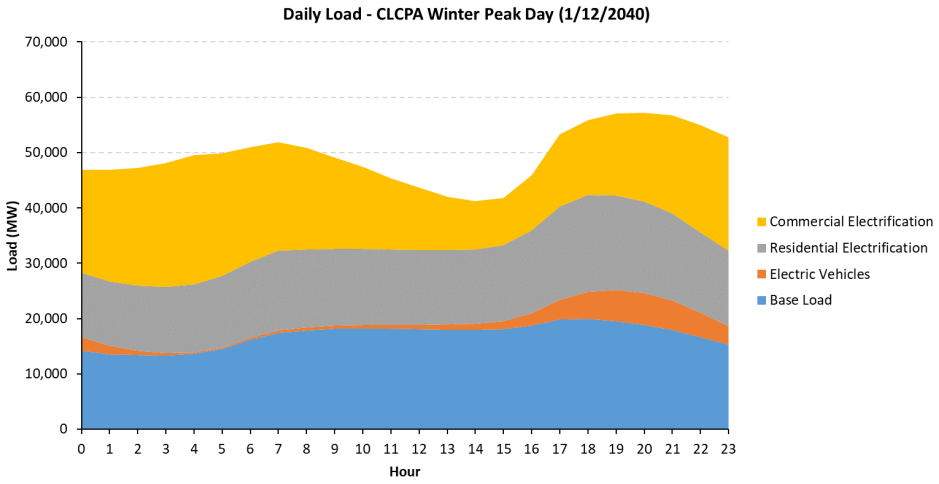
A. Input Data to Electric System Model

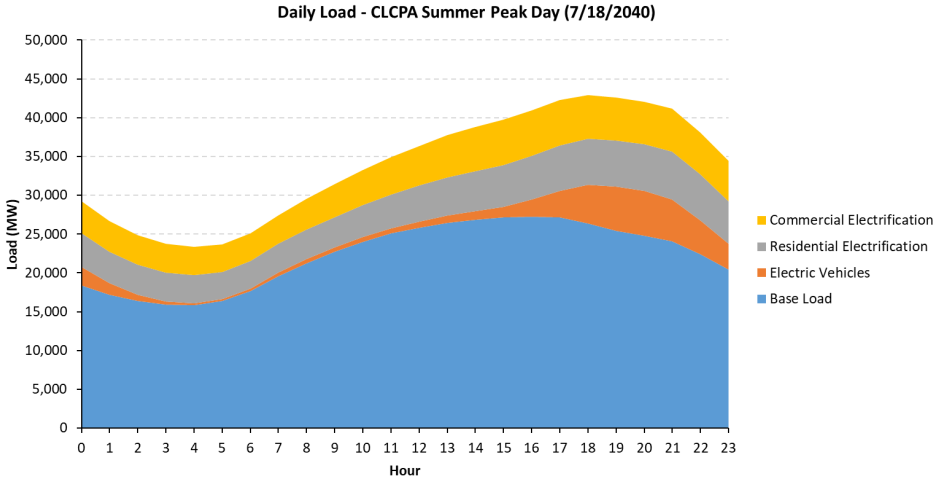
1. Phase I Load Data

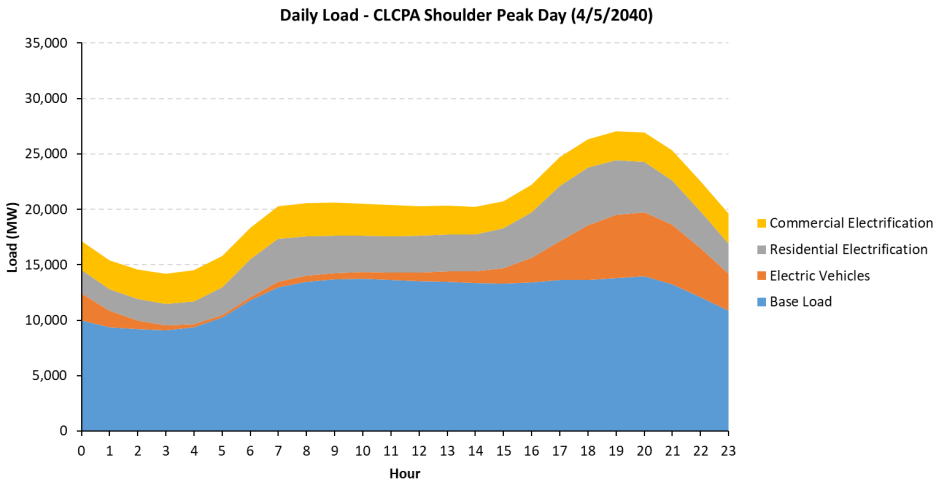
The Phase 1 load data is made up of four scenarios:

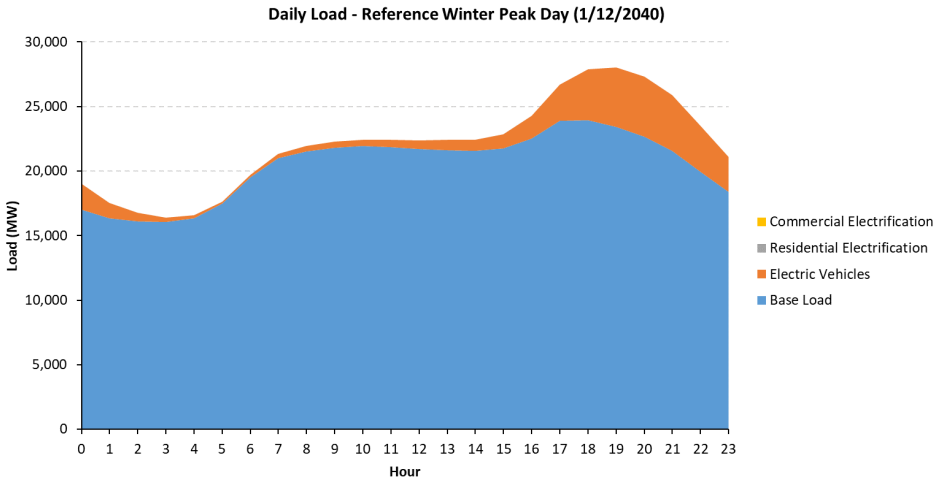
- Reference Case – Load growth based on Gold Book 2019 Estimates with 0.7° F per decade average temperature increase.
- Accelerated Climate Change Case – Reference Case with assumption of 1.4° F per decade average temperature increase.
- State Policy Case – Increased energy efficiency to meet NY Clean Energy Standard goals; increased BTM PV, EV, and heating electrification.
- CLCPA Case – 85 percent reduction in overall GHG by 2050, large scale electrification in residential and commercial sectors; 85 percent reduction in transportation GHG.

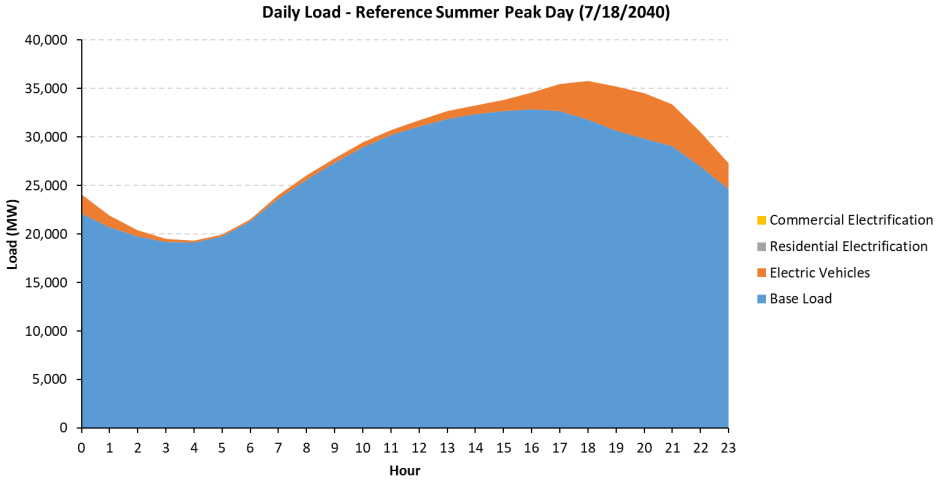
This study focuses on the Reference and CLCPA cases. We further focus on three 30-day modeling periods: Winter (January 2040), Summer (July 2040), and Off-peak (April 2040). The total load in the CLCPA winter and summer peak days is significantly higher than the Reference Case, due to Commercial and Residential electrification loads. The daily load for the CLCPA case winter, summer, and shoulder season peak days are shown below, as compared to the Reference Case winter, summer, and shoulder season peak days.

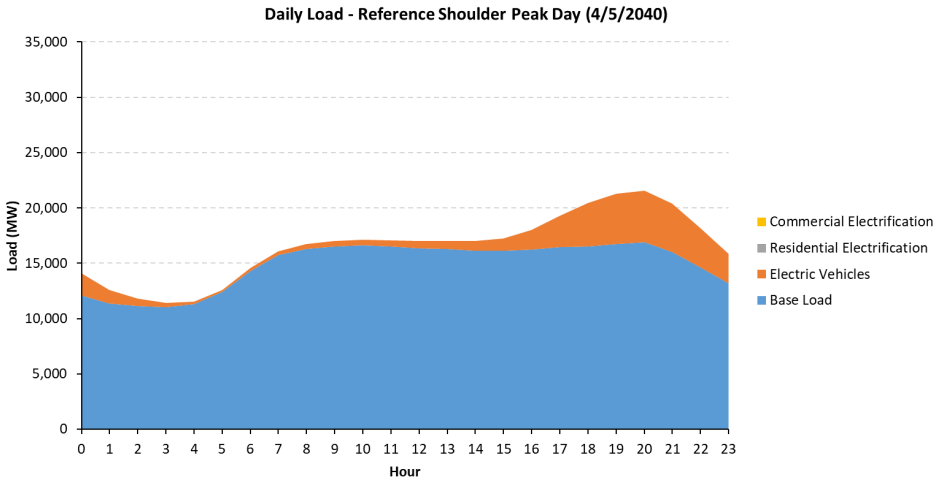

Daily Load - CLCPA Winter Peak Day (1/12/2040)
Load (MW)
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Hour
Commercial Electrification
Residential Electrification
Electric Vehicles
Base Load


Daily Load - CLCPA Summer Peak Day (7/18/2040)
Load (MW)
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Hour
Commercial Electrification
Residential Electrification
Electric Vehicles
Base Load


Daily Load - CLCPA Shoulder Peak Day (4/5/2040)
Load (MW)
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Hour
Commercial Electrification
Residential Electrification
Electric Vehicles
Base Load


Daily Load - Reference Winter Peak Day (1/12/2040)
Load (MW)
30,000
25,000
20,000
15,000
10,000
5,000
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Hour
Commercial Electrification
Residential Electrification
Electric Vehicles
Base Load


Daily Load - Reference Summer Peak Day (7/18/2040)
Load (MW)
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Hour
Commercial Electrification
Residential Electrification
Electric Vehicles
Base Load


Daily Load - Reference Shoulder Peak Day (4/5/2040)
Load (MW)
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Hour
Commercial Electrification
Residential Electrification
Electric Vehicles
Base Load

Demand during the shoulder, winter, and summer seasonal modeling periods broken out by source is summarized below:

Winter Modeling Period Total Demand

Total Demand (GWh)	Reference	CLCPA
Base Load	13,039	10,836
Electric Vehicles	1,073	1,332
Residential Electrification	0	7,215
Commercial Electrification	0	7,939
Total Adjusted Load	**14,111**	**27,322**

Summer Modeling Period Total Demand

Total Demand (GWh)	Reference	CLCPA
Base Load	17,940	14,882
Electric Vehicles	1,073	1,332
Residential Electrification	0	3,156
Commercial Electrification	0	3,106
Total Adjusted Load	**19,013**	**22,476**

Shoulder Modeling Period Total Demand

Total Demand (GWh)	Reference	CLCPA
Base Load	10,304	8,509
Electric Vehicles	1,081	1,342
Residential Electrification	0	1,410
Commercial Electrification	0	1,236
Total Adjusted Load	**11,385**	**12,497**

2. NREL wind and solar profiles

Land-based and offshore wind profiles are based on 2009 synchronous NREL data. The land-based wind data is acquired from NREL's Wind Toolkit Database using 721 weather sites in NY.[73] Offshore wind data is also from the NREL Wind Toolkit Database, and uses 13 clusters of simulated offshore wind locations near NY. The simulated data is from 2009 and aggregated at a zonal level.

Grid-connected and BTM solar profiles are based on synchronous NREL data (2006 measurements). The BTM solar profiles uses data from NREL's PV-Watt tool for 18 stations across NY State.[74] Grid-connected solar data is from NREL's Solar Power Database using 62 simulated solar farm sites in NY.[75]

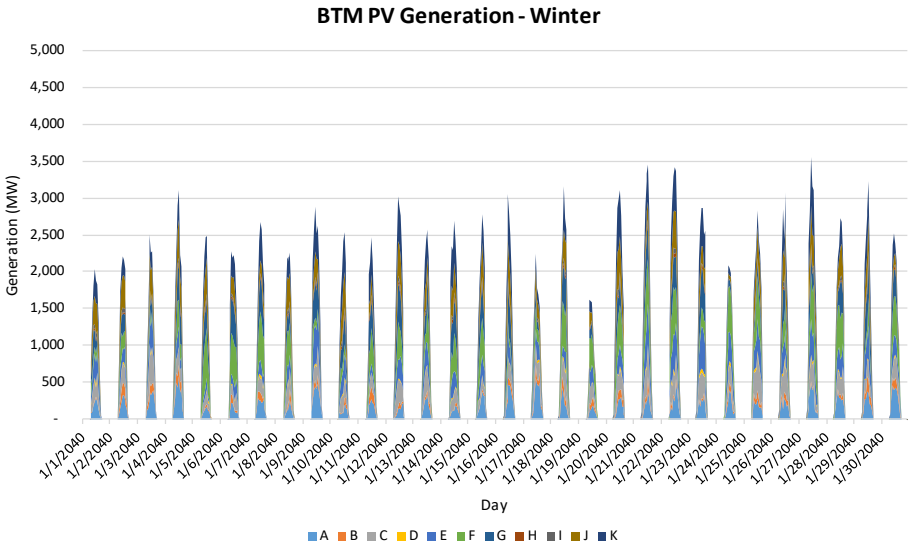
All wind and solar datasets were developed by the CARIS team for the 70x30 scenario from the publicly available simulated NREL data.

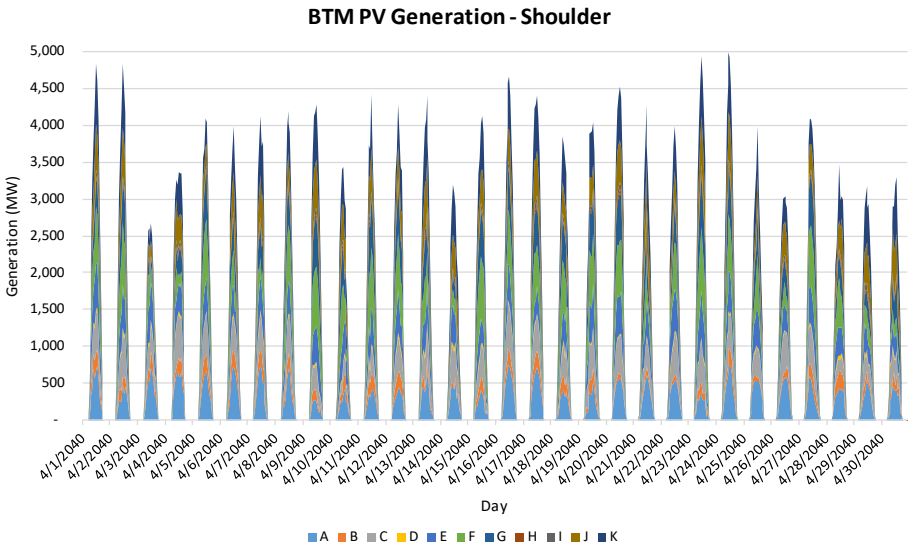
[73] NREL Wind Toolkit Database, https://www.nrel.gov/grid/wind-toolkit.html.

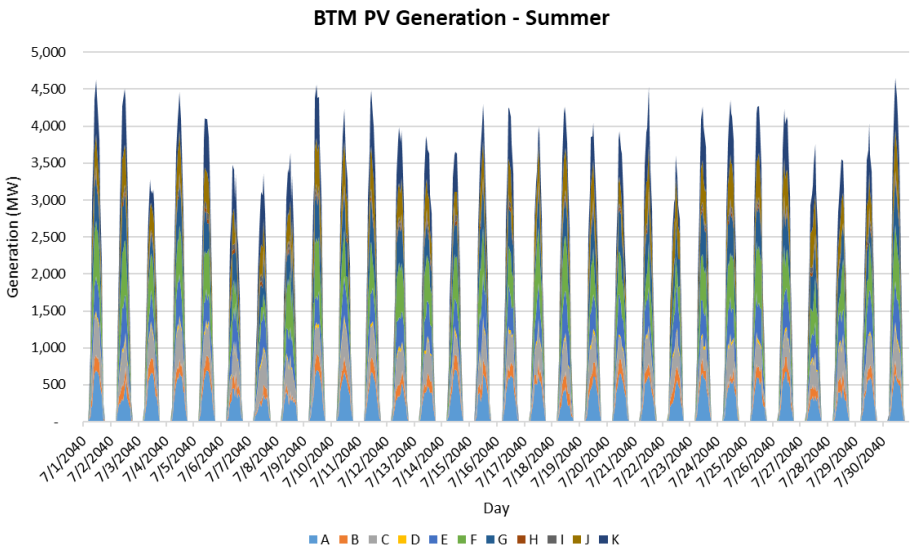
[74] NREL PVWatts Calculator, https://pvwatts.nrel.gov/.

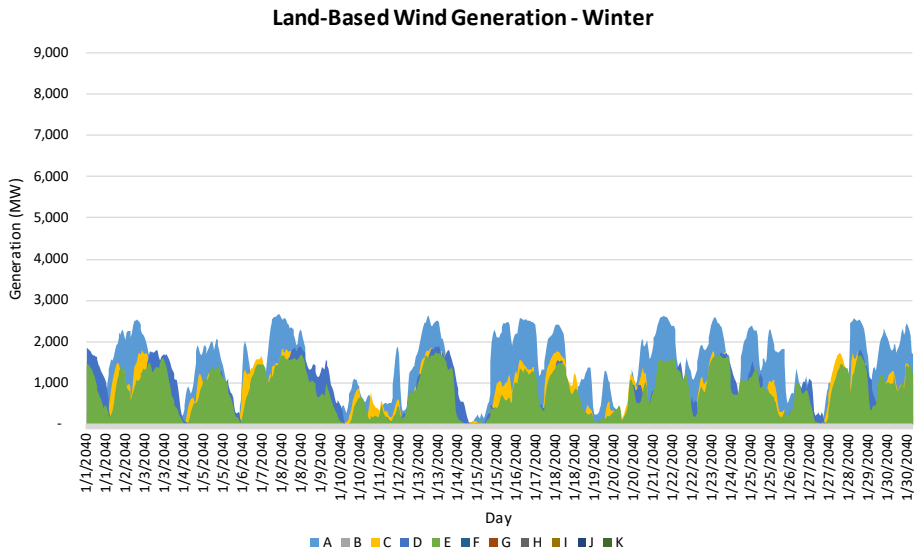
[75] NREL Solar Power Database, https://www.nrel.gov/grid/solar-power-data.html.

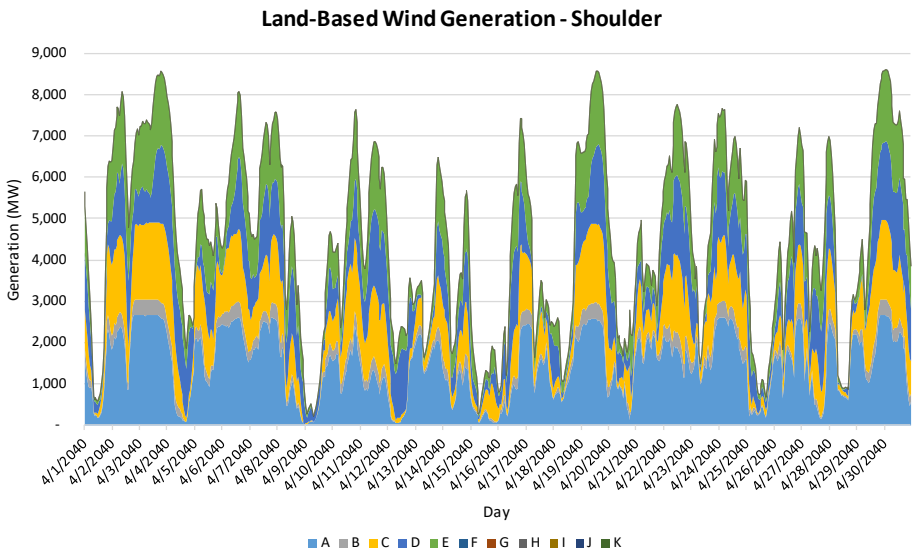
The below charts show the profiles for land-based and offshore wind, and grid-connected and BTM solar during the three seasonal modeling periods.

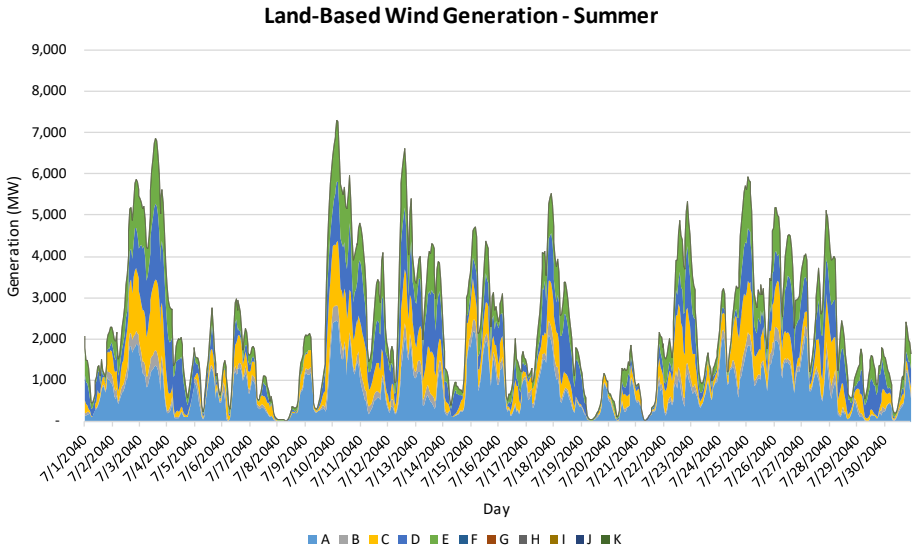





BTM PV Generation - Summer
Generation (MW)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
-
7/1/2040 7/2/2040 7/3/2040 7/4/2040 7/5/2040 7/6/2040 7/7/2040 7/8/2040 7/9/2040 7/10/2040 7/11/2040 7/12/2040 7/13/2040 7/14/2040 7/15/2040 7/16/2040 7/17/2040 7/18/2040 7/19/2040 7/20/2040 7/21/2040 7/22/2040 7/23/2040 7/24/2040 7/25/2040 7/26/2040 7/27/2040 7/28/2040 7/29/2040 7/30/2040
Day
A B C D E F G H I J K


Land-Based Wind Generation - Winter
Generation (MW)
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
-
1/1/2040 1/1/2040 1/2/2040 1/3/2040 1/3/2040 1/4/2040 1/5/2040 1/5/2040 1/6/2040 1/7/2040 1/8/2040 1/8/2040 1/9/2040 1/10/2040 1/10/2040 1/11/2040 1/12/2040 1/13/2040 1/13/2040 1/14/2040 1/15/2040 1/15/2040 1/16/2040 1/17/2040 1/18/2040 1/18/2040 1/19/2040 1/20/2040 1/20/2040 1/21/2040 1/22/2040 1/22/2040 1/23/2040 1/24/2040 1/25/2040 1/25/2040 1/26/2040 1/27/2040 1/27/2040 1/28/2040 1/29/2040 1/30/2040 1/30/2040
Day
A B C D E F G H I J K





3. NREL data for wind lulls

The NREL Wind Toolkit is a data set of observed wind speeds each hour from 100 meter wind turbines from 2007 – 2013.[76] The power data set, used to calculate the wind profiles at three sites in New York, estimates the power produced at each turbine site using a power curve appropriate for each site.[77] The capacity factor in each hour was then calculated by dividing the power by the maximum amount of power that the turbine can produce in one hour.

[76] NREL Wind Toolkit Database, https://www.nrel.gov/grid/wind-toolkit.html.

[77] King, J., A. Clifton, and B.M. Hodge, "Validation of Power Output for the WIND Toolkit", 2014, available at https://www.nrel.gov/docs/fy14osti/61714.pdf.