Fuel and Energy Security Study Assumptions and Data

NYISO ICAPWG/MIWG

April 15, 2019

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Context and Assignment

- This presentation will provide further detail on the proposed input assumptions and sources of data that feed into the fuel security model, along with alternative assumptions and system stress scenarios
- Data used are a mix of publicly-available data and NYISO internal data, with preference for assumptions previously vetted with stakeholders (where possible)

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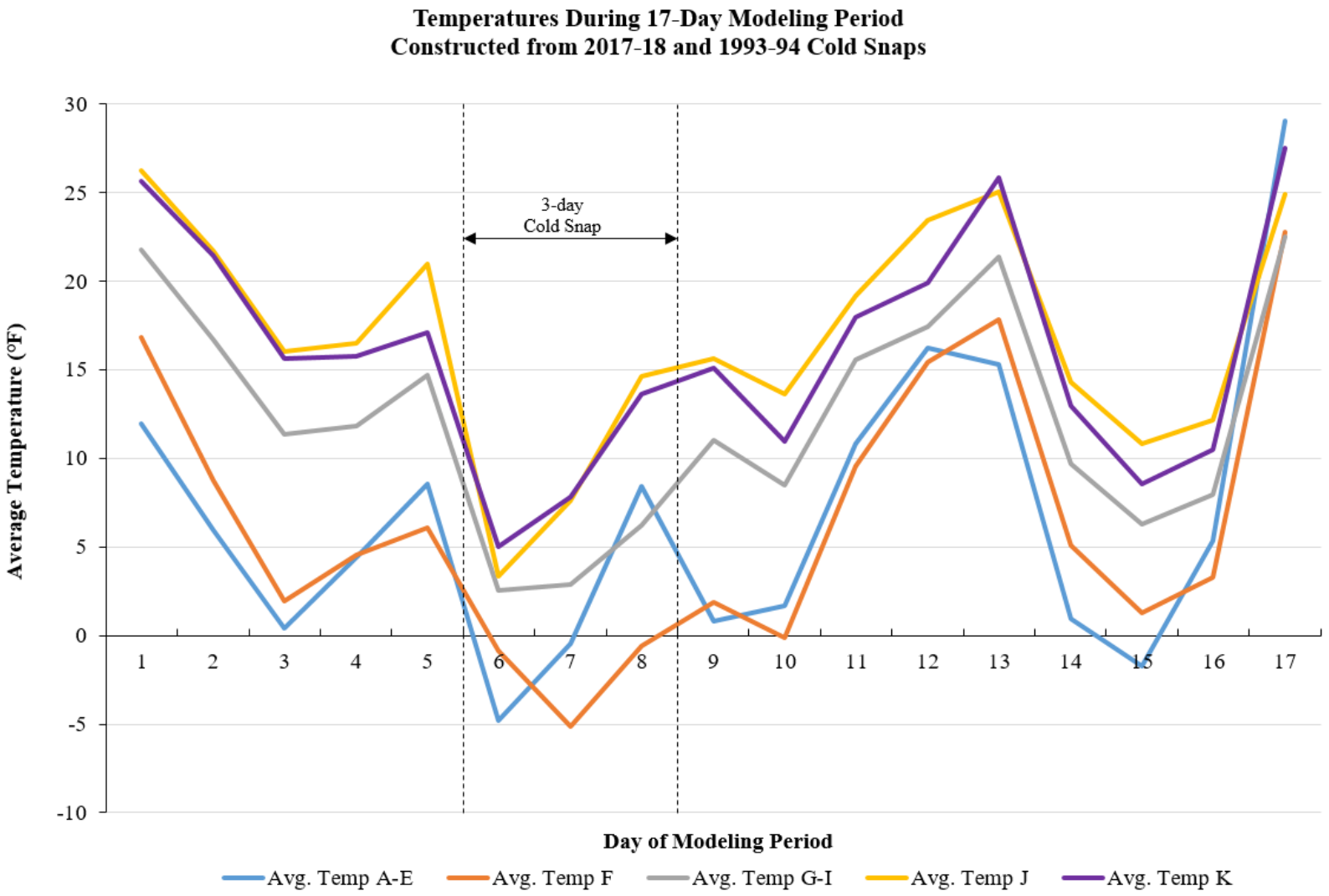
Weather

- In the fuel security model, decreasing temperature has two effects:
  - Increase in LDC gas demand
  - Increase in electrical demand
- **Proposed initial scenario assumptions**: 17 day period (including 3 day "cold snap") based on Winter 2017-18 average temperature profile with Winter 1993-94 cold snap profile
- Coldest 3-day period is assumed on days 6 through 8 of the modeling period

Temperature during Modeling Period



Source:
[1] NYISO Weather Data 1993-2018.

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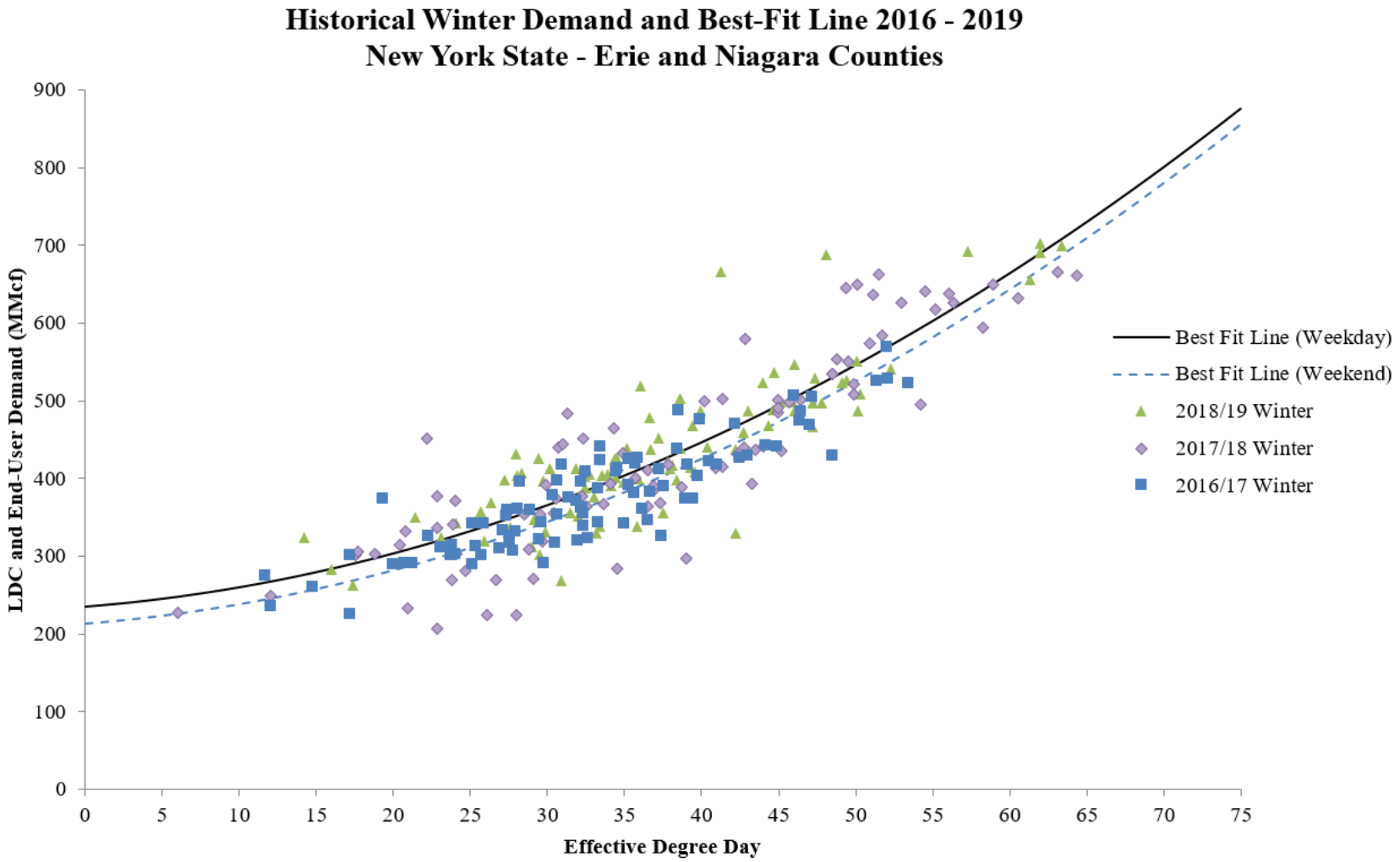
Gas LDC Demand

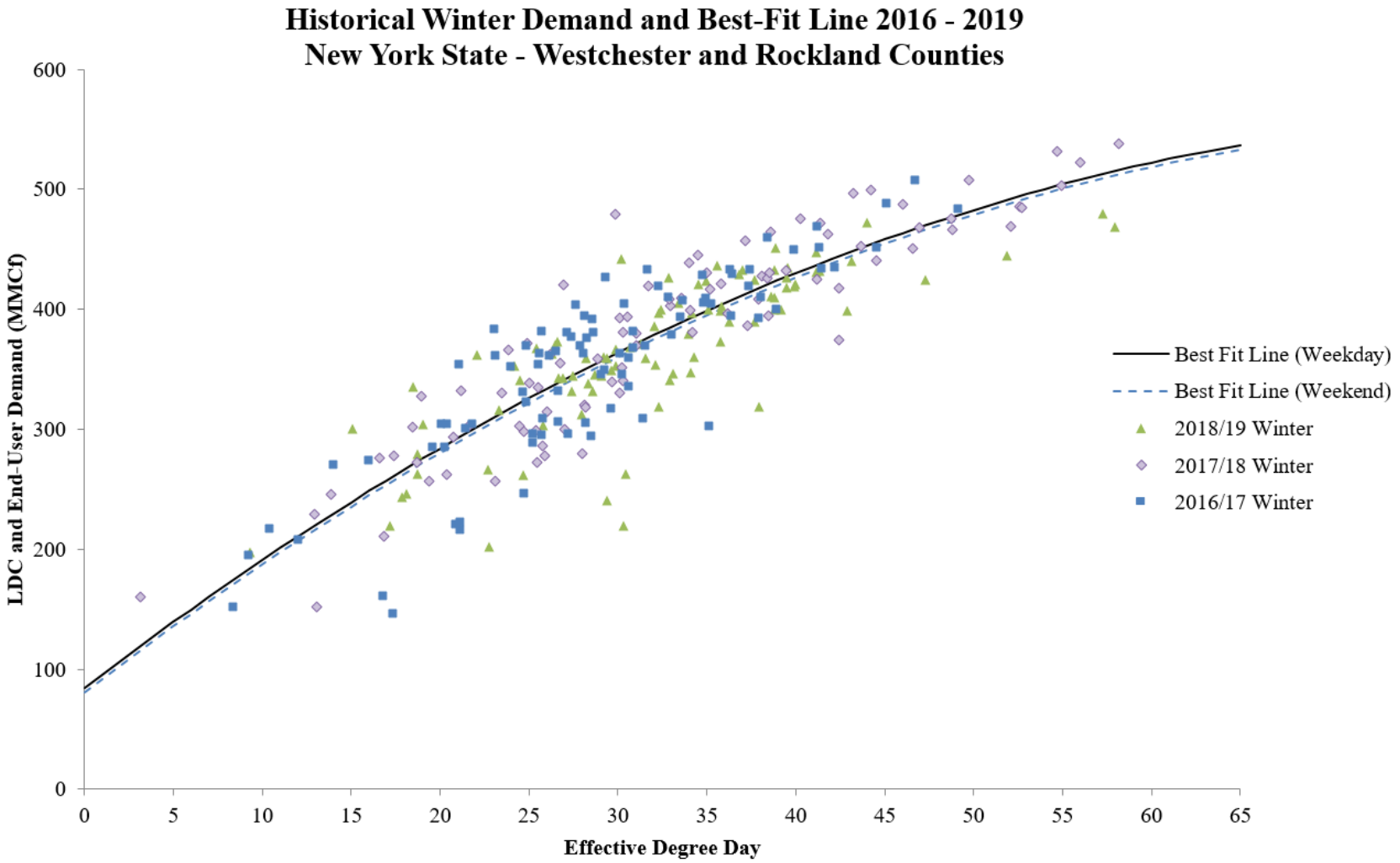
- Model of daily LDC gas demand by heating effective degree day (EDD)
  - NYISO weather data for winters 2016/17, 2017/18, 2018/19
  - Historical winter gas flow data from SNL using Intraday 3 nominations
  - Estimated separately for upstate and downstate
  - Reduced gas demand estimated for weekends and holidays
- For each day in 17-day modeling period, total LDC gas demand for upstate and downstate is scaled based on LDC Design Day documentation

LDC Demand vs Degree Day - Upstate



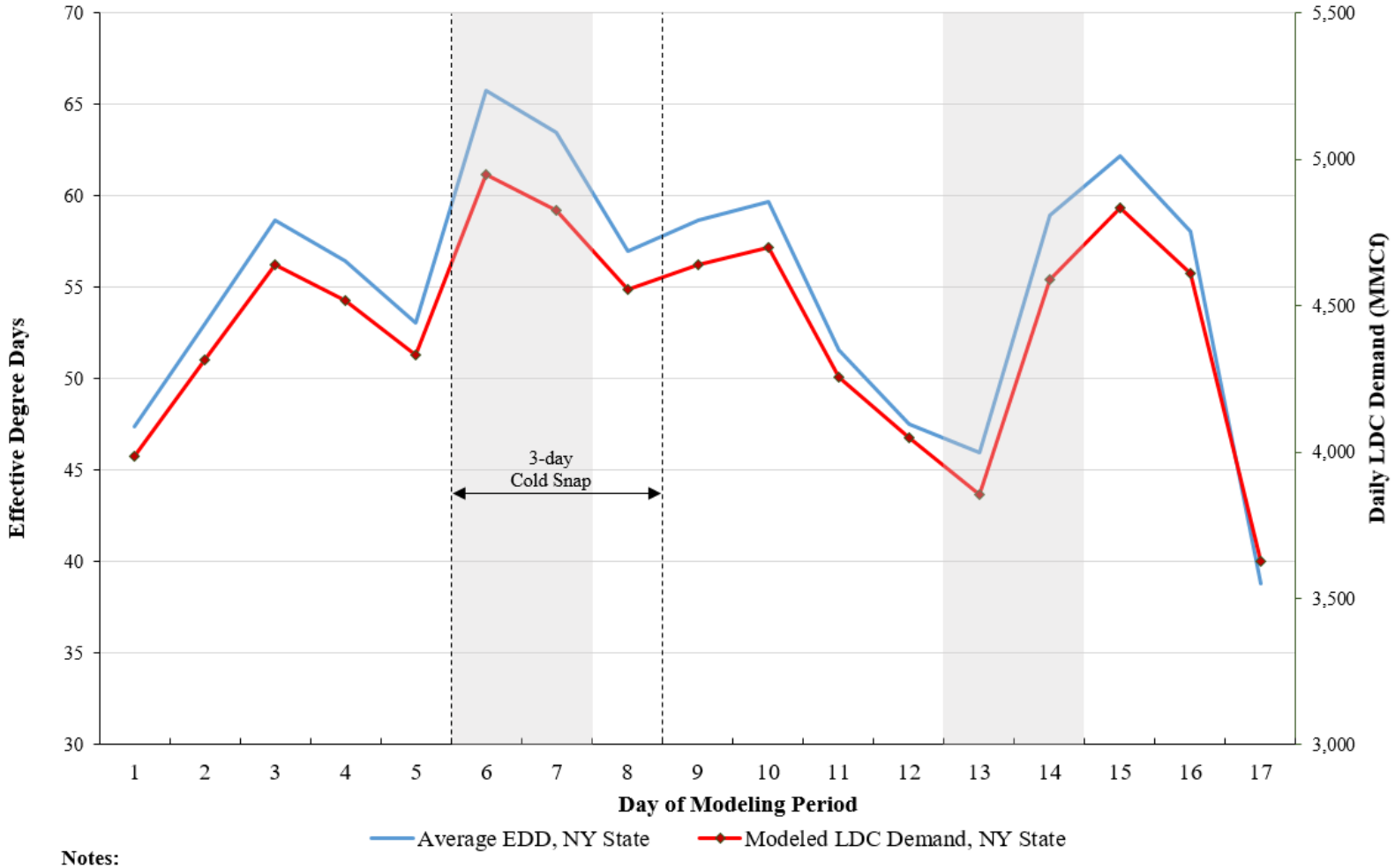
Notes:
[1] Total deliveries are the sum of scheduled capacity during the intraday 3 nomination cycle to LDCs and End Users. Chart includes all Erie and Niagara county gas points in the National Fuel Gas LDC territory not located right next to a gas power plant.
[2] Winter is defined as December, January, and February.
[3] Effective degree day is defined as 65 degrees - Dry Bulb Temperature, and is taken from Zone A temperature data.
Sources:
[A] LDC and End-User Demand: S&P Global Market Intelligence.
[B] Temperature: NYISO.

LDC Demand vs Degree Day - Downstate



Notes:
[1] Total deliveries are the sum of scheduled capacity during the intraday 3 nomination cycle to LDCs and End Users. Chart includes all Westchester and Rockland county gas points not located right next to a gas power plant.
[2] Winter is defined as December, January, and February.
[3] Effective degree day is defined as 65 degrees - Dry Bulb Temperature, and is taken as the simple average of Zone H and Zone I temperature data.
Sources:
[A] LDC and End-User Demand: S&P Global Market Intelligence.
[B] Temperature: NYISO.

Degree Days and LDC Demand During 17-Day Modeling Period



Notes:
[1] Weekends are shaded in gray.
[2] Effective degree day is defined as 65 degrees F - Temperature.
Sources:
[1] NYISO Weather and Load Data 1993-2018.
[2] S&P Global Market Intelligence.

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Gas Pipeline Net Supply for Generation

- Based on review of LDC documents, essentially all of pipeline export capacity from New York to New England is assumed to be under firm contract to deliver flowing gas or transport stored gas
- **Gas available for Electric Generation on LDC Design Day =**
  [Expected Pipeline Imports
  – Max Pipeline Exports to NE
  – LDC Design Day Demand]
- No LNG or storage capacity is assumed to be available for delivery to generators
- Gas supply is assumed to be transferable within New York; except for certain assumed limitations downstate

New York State Modeling Period Gas Supply and Demand (MMCF/d)

Gas Supply/Demand	MMCF/d	Calculation	Source
Modeling Period Supply			
Max New York State Imports from PJM	9,846	[A]	EIA
Expected New York State Net Imports from Ontario	400	[B]	NYISO
Gas Available within New York	***10,246***	***[C] = [A] + [B]***	
Modeling Period Demand			
Max Exports to New England	(4,087)	[D]	EIA
New York Design Day LDC Demand from Pipeline Gas	(5,270)	[E]	NYDPS
Total Outflows/LDC Demand	***(9,357)***	***[F] = [D]+[E]***	
Max Gas Available for Electric Generation in New York	**889**	**[G] = [C] + [F]**	
Equivalent MW of Gas Generation Capacity each Hour at 8 MMBtu/MWh Heat Rate	**4,804**	**[H] = [G] * 5.4**	

Note:
[1] Design Day LDC Demand aggregated from Winter Supply forms and 10-K financials for New York State LDCs.

Sources:
[1] EIA, State to State Pipeline Capacity, January 31, 2019.
[2] NYDPS/NYPSC, Case 18-M-0272 - Winter Supply 2018-2018 Forms, Table 1.
[3] Consolidated Edison, Inc. and Consolidated Edison Company of New York, Inc. Form 10-K, for the fiscal year ended December 31, 2017, p. 24.

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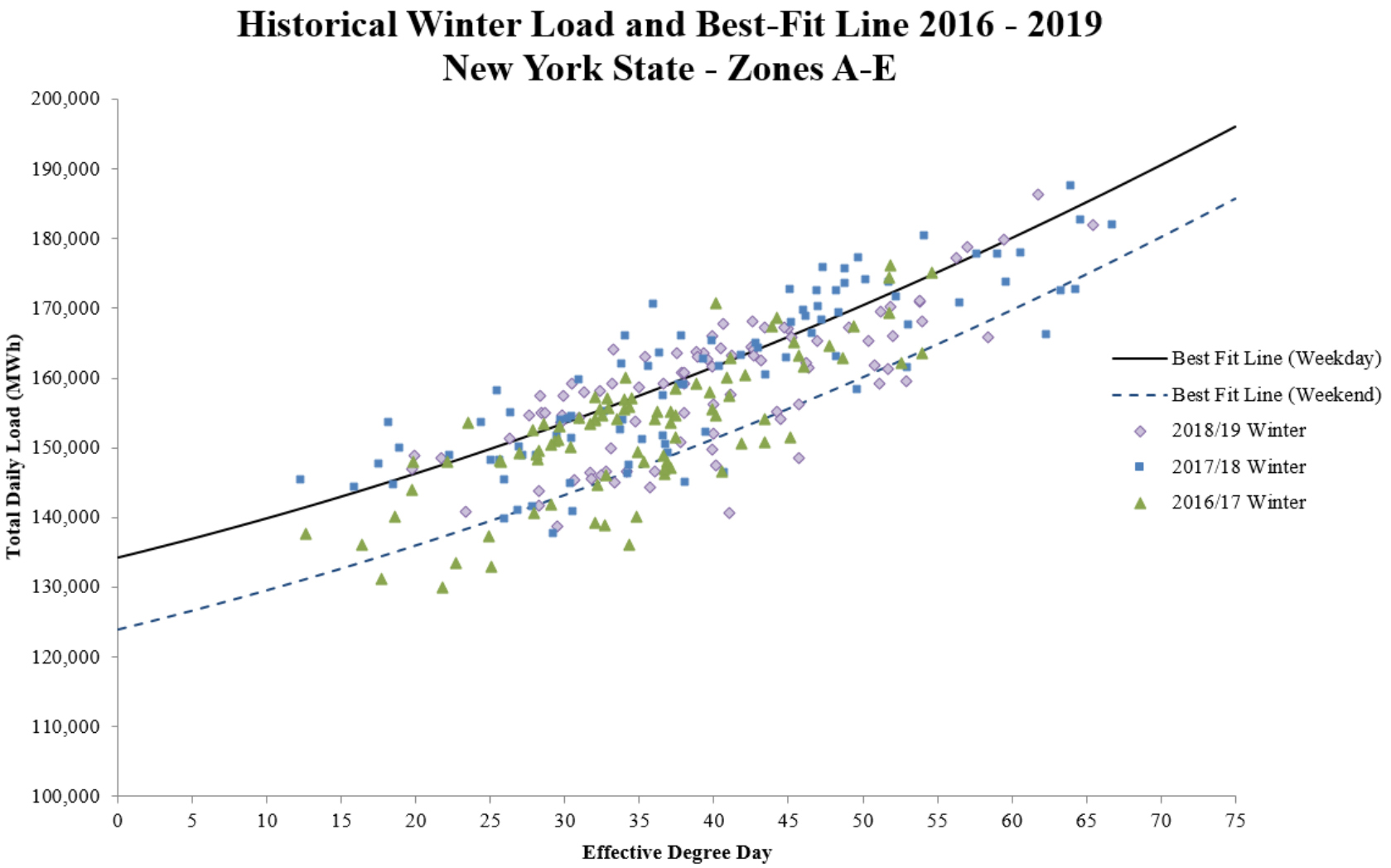
Electrical Demand Daily Model

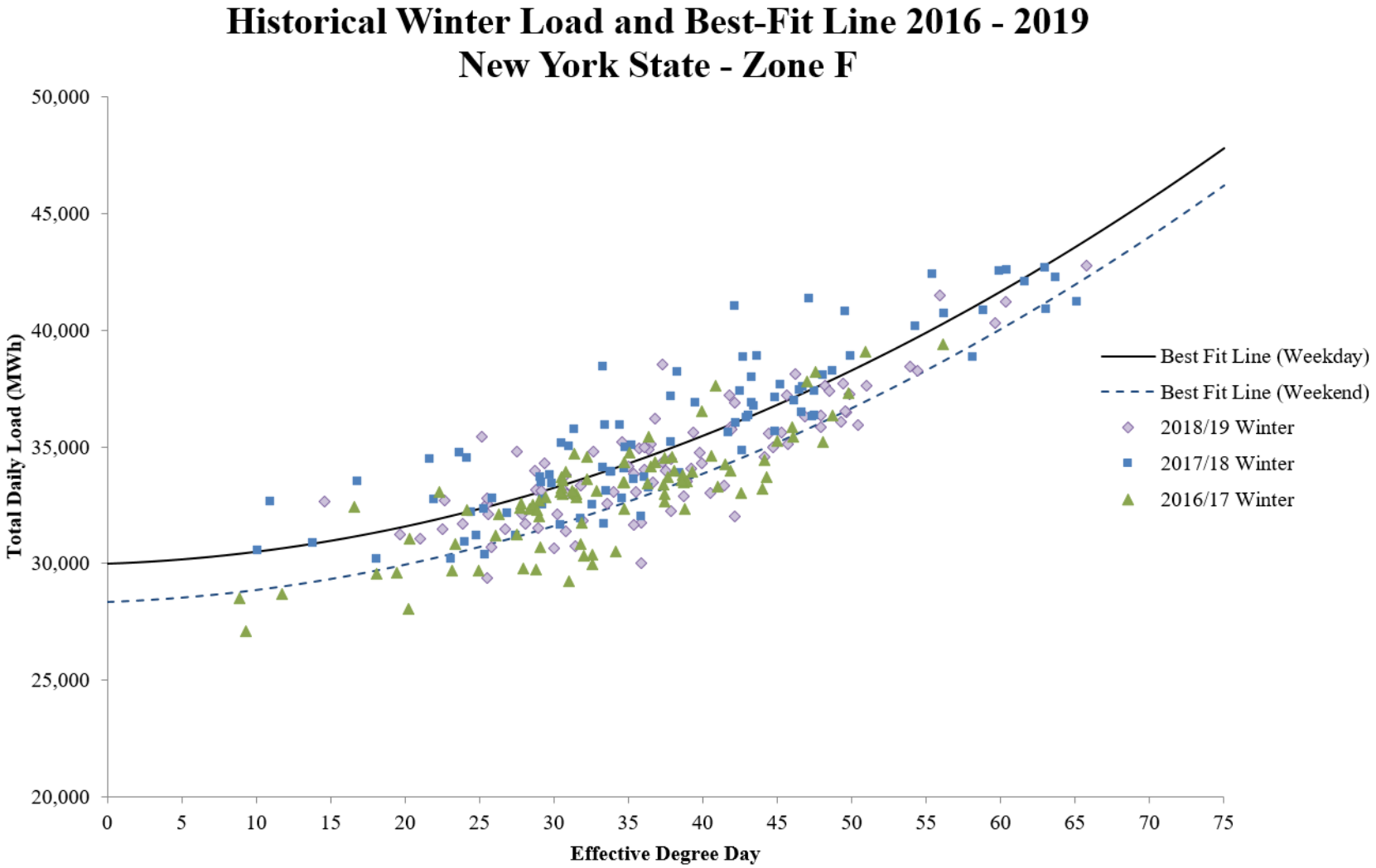
- Model of daily energy usage (in MWh) by heating effective degree day (EDD)
  - NYISO load and weather data for winters 2016/17, 2017/18, 2018/19
  - Estimated separately for each of the following regions
    - Load Zones A-E
    - Load Zones F
    - Load Zones G-I
    - Load Zones J
    - Load Zones K
  - Reduced electric load estimated for weekends and holidays
- For each day in 17-day modeling period, total daily energy demand by region is scaled based on EDD from daily temperature profile

Load vs Degree Day – Zone A-E



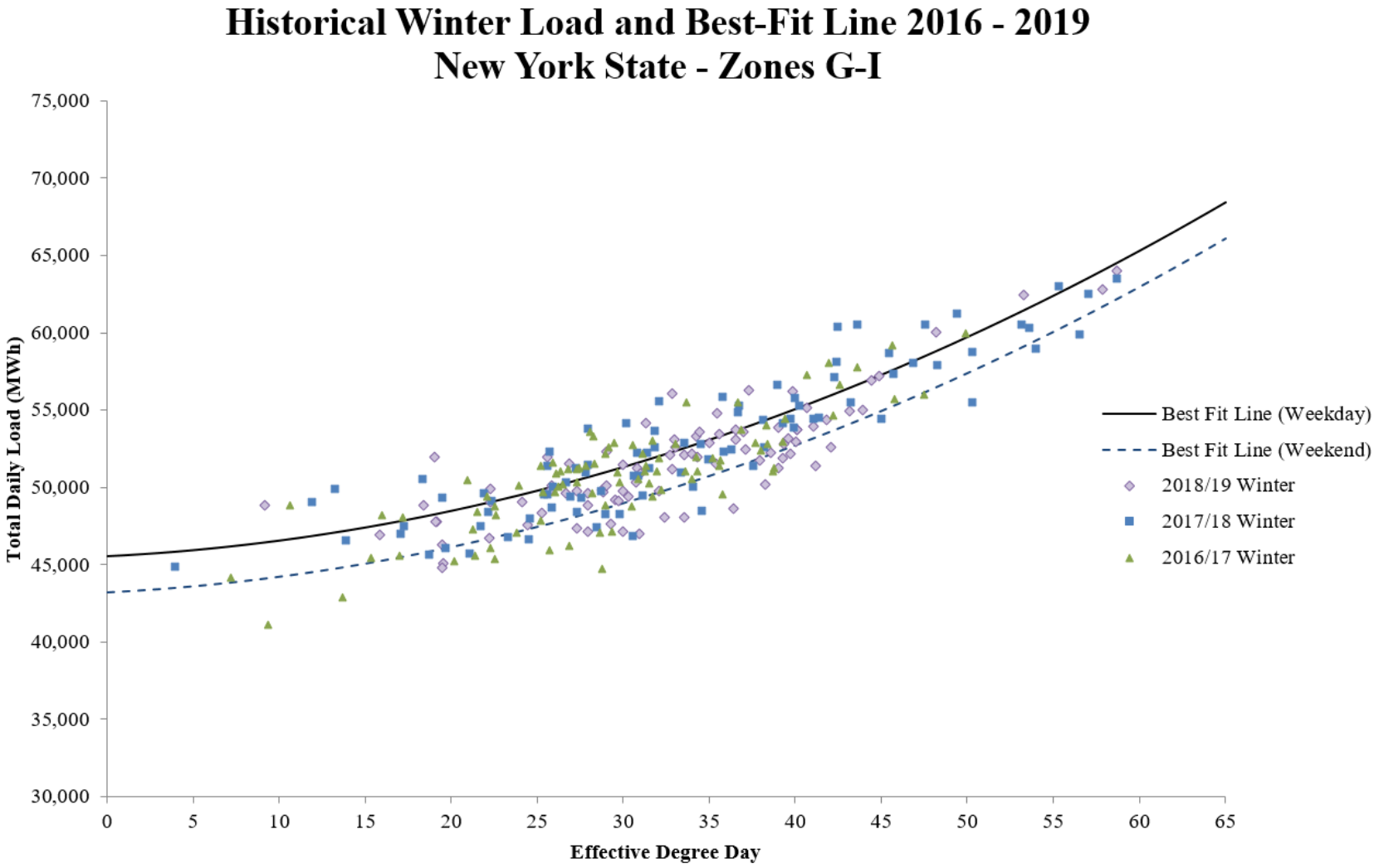
Notes:
[1] Winter is defined as December, January, and February.
[2] Effective degree day is defined as 65 degrees - Temperature.
Source:
[A] Load and Temperature: NYISO.

Load vs Degree Day – Zone F



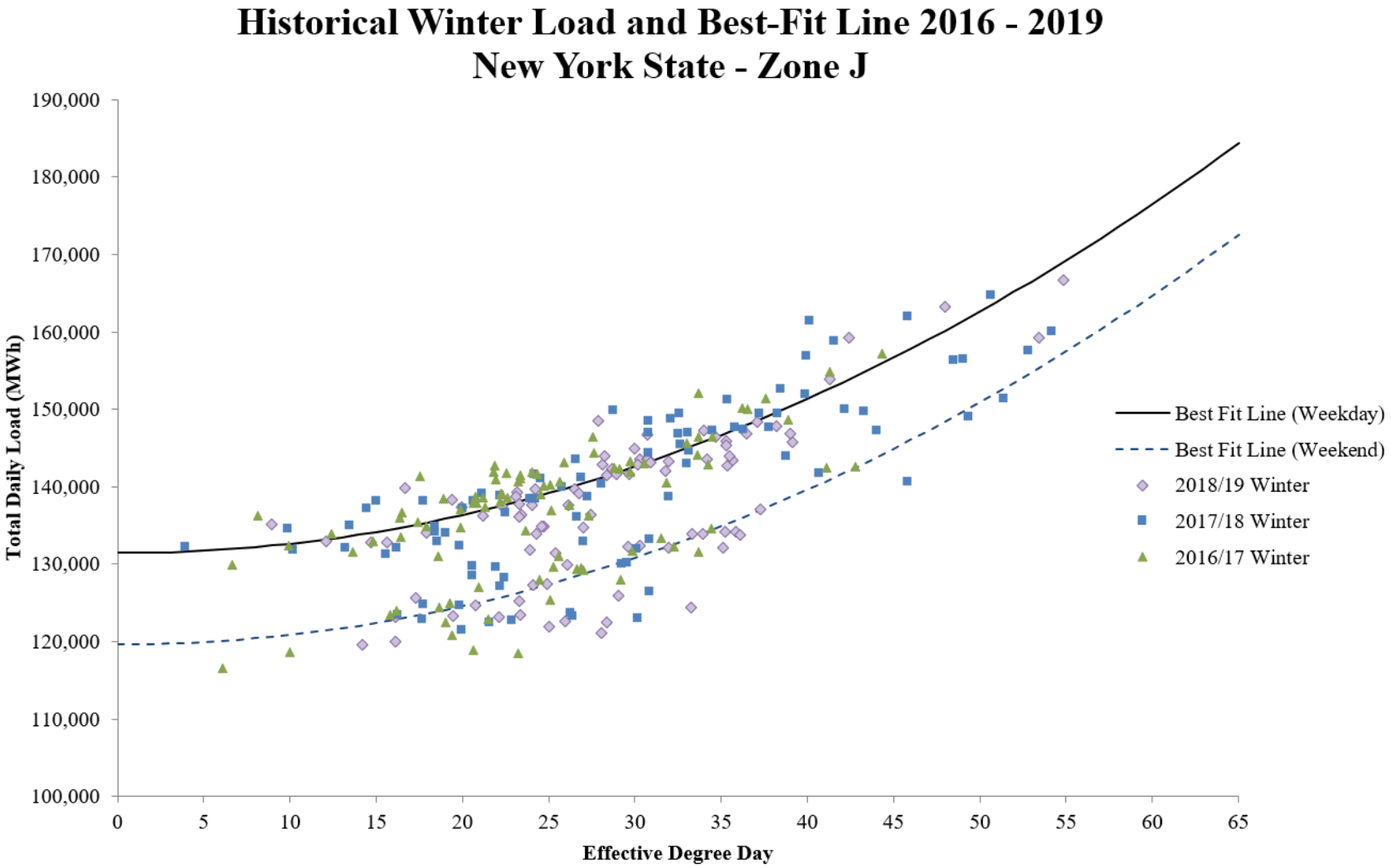
Notes:
[1] Winter is defined as December, January, and February.
[2] Effective degree day is defined as 65 degrees - Temperature.
Source:
[A] Load and Temperature: NYISO.

Load vs Degree Day – Zone G-I



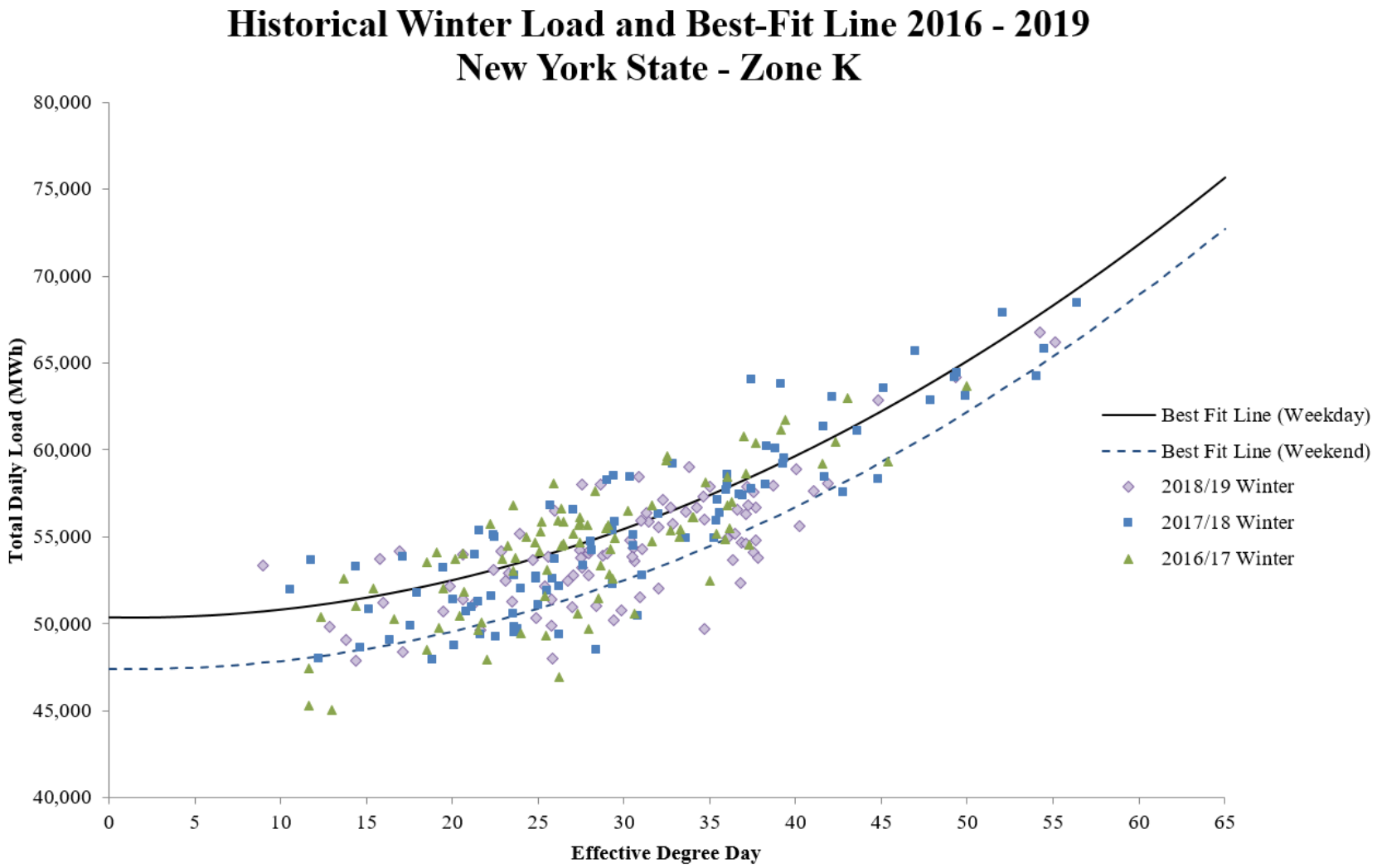
Notes:
[1] Winter is defined as December, January, and February.
[2] Effective degree day is defined as 65 degrees - Temperature.
Source:
[A] Load and Temperature: NYISO.

Load vs Degree Day – Zone J



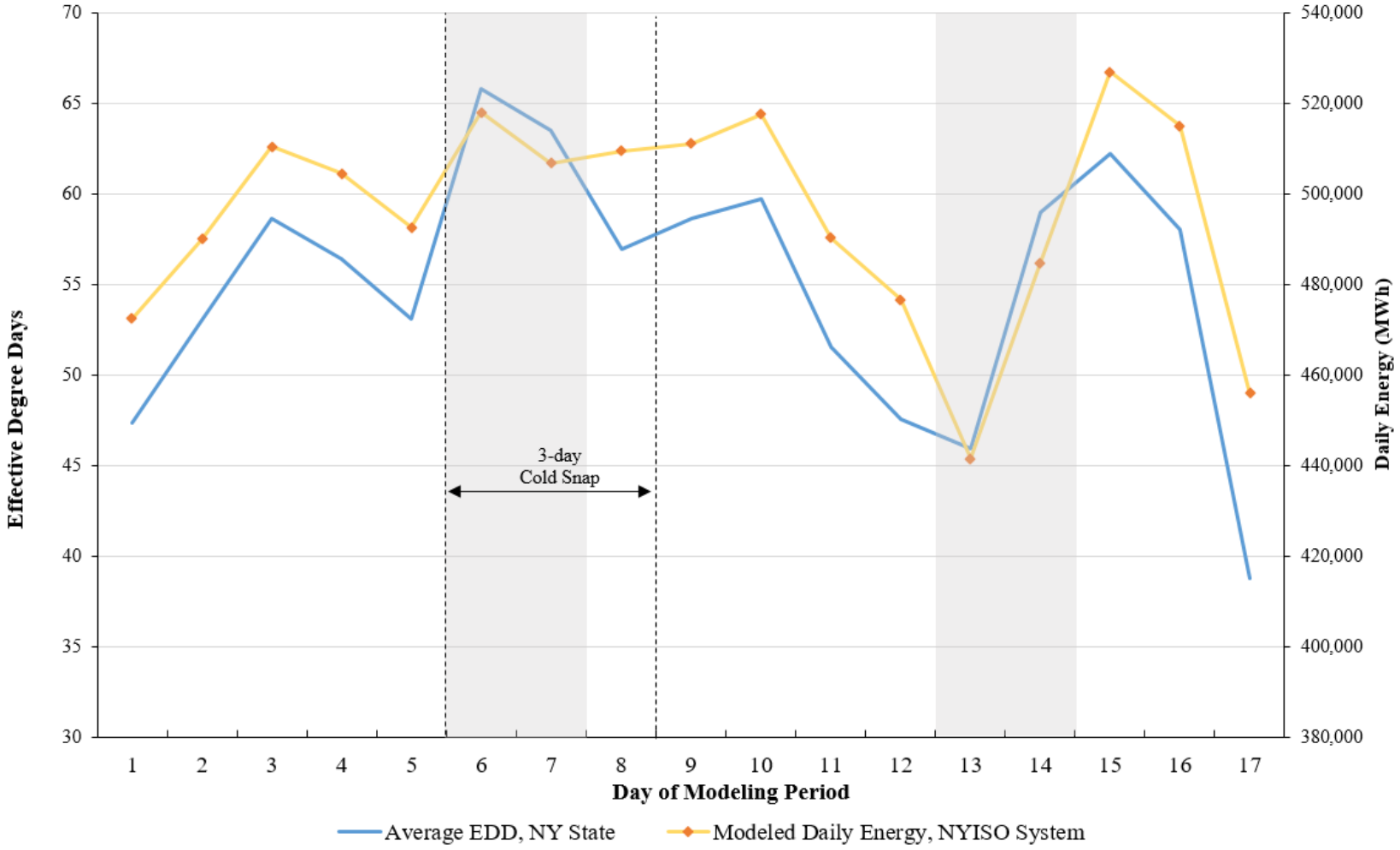
Notes:
[1] Winter is defined as December, January, and February.
[2] Effective degree day is defined as 65 degrees - Temperature.
Source:
[A] Load and Temperature: NYISO.

Load vs Degree Day – Zone K



Notes:
[1] Winter is defined as December, January, and February.
[2] Effective degree day is defined as 65 degrees - Temperature.
Source:
[A] Load and Temperature: NYISO.

Degree Days and Load During 17-Day Modeling Period

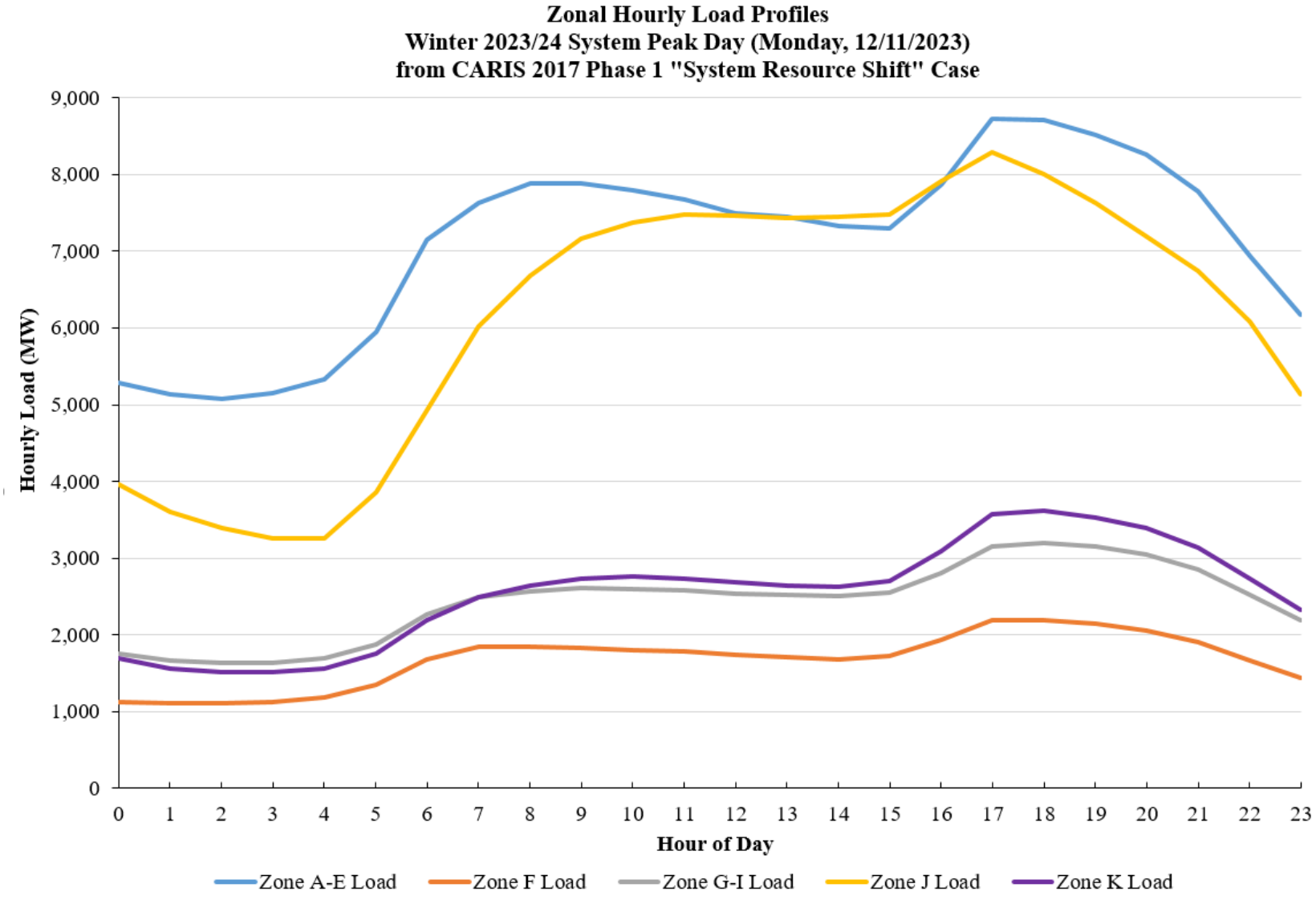


Notes:
[1] Weekends are shaded in gray.
[2] Effective degree day is defined as 65 degrees F - Temperature.
Source:
[1] NYISO Weather and Load Data 1993-2018.

Electrical Demand Hourly Shape

- Load/Temperature model calibrated to Winter 2023/24 peak day from 2017 CARIS Phase 1 "System Resource Shift" case of December 11, 2023.
  - Implied EDD for each zone based on historical weather originally used to derive load shape used for the CARIS analysis.
- For each day in 17-day modeling period, total daily energy by region is scaled based on EDD from daily temperature profile
  - Intraday load shape preserved from the CARIS analysis

Winter 2023/24 System Peak Day Intraday Hourly Profile



Sources:
NYISO CARIS 2017 Phase 1 "System Resource Shift" Case Load Data for 2023.

Winter 2023/24 System Peak Day Summary Statistics

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Statistics for 2023/24 Winter Peak Day

Zone Group	Values for Monday, December 11, 2023		
	Implied Average Temp.	Implied Daily Average EDD	Total Daily Energy, CARIS 2023/24 (MWh)
A-E	12.0	53.0	170,532
F	12.4	52.6	40,238
G-I	18.3	46.7	58,442
J	24.8	40.2	147,842
K	22.6	42.4	61,216

Notes:

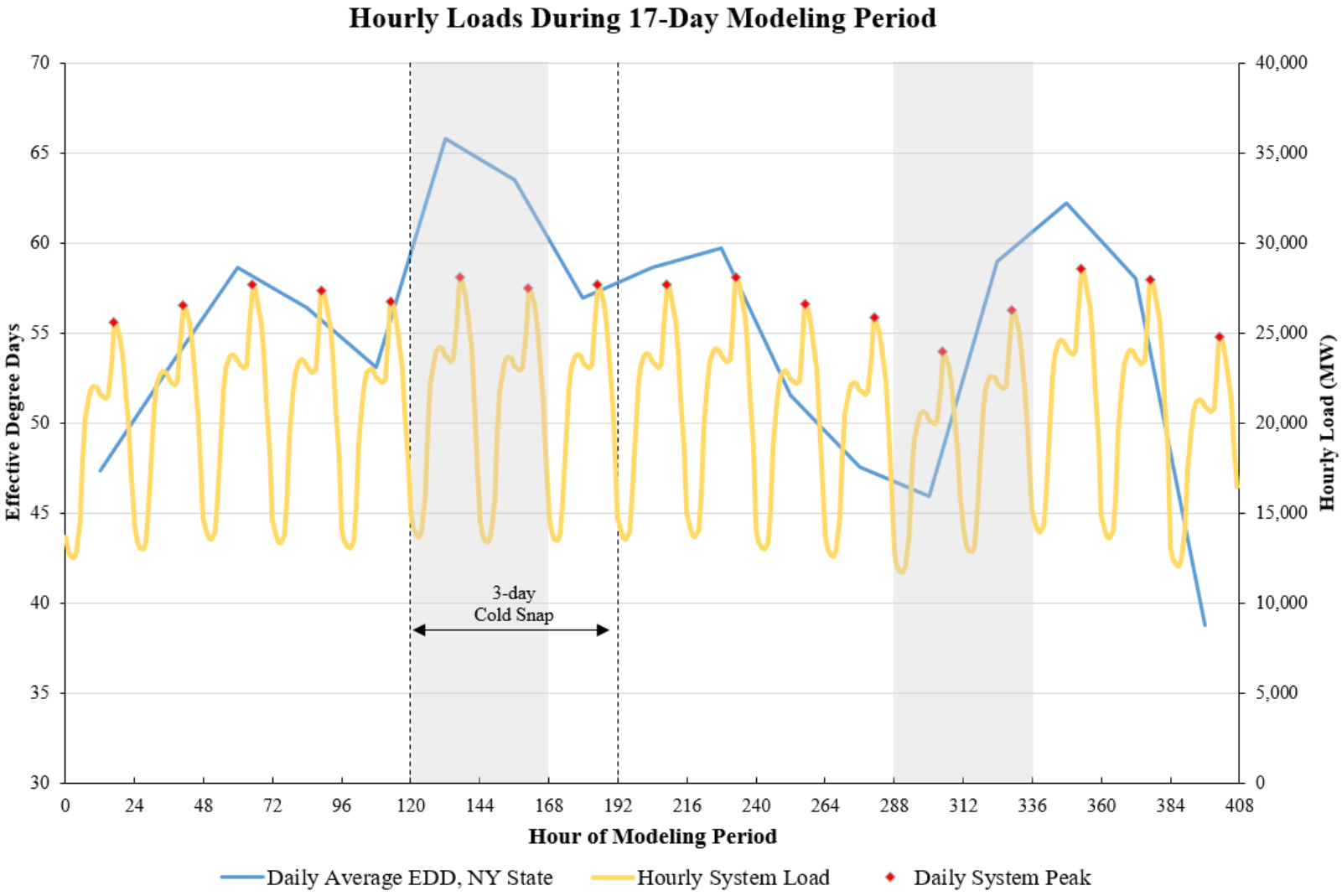
[1] Implied Temperature and EDD are from December 9, 2002, the corresponding day used to generate the load profile.

[2] Daily Average EDD is defined as 65 - Dry Bulb Temperature.

Sources:

[1] NYISO CARIS 2017 Phase 1 "System Resource Shift" Case Load Data for 2023.

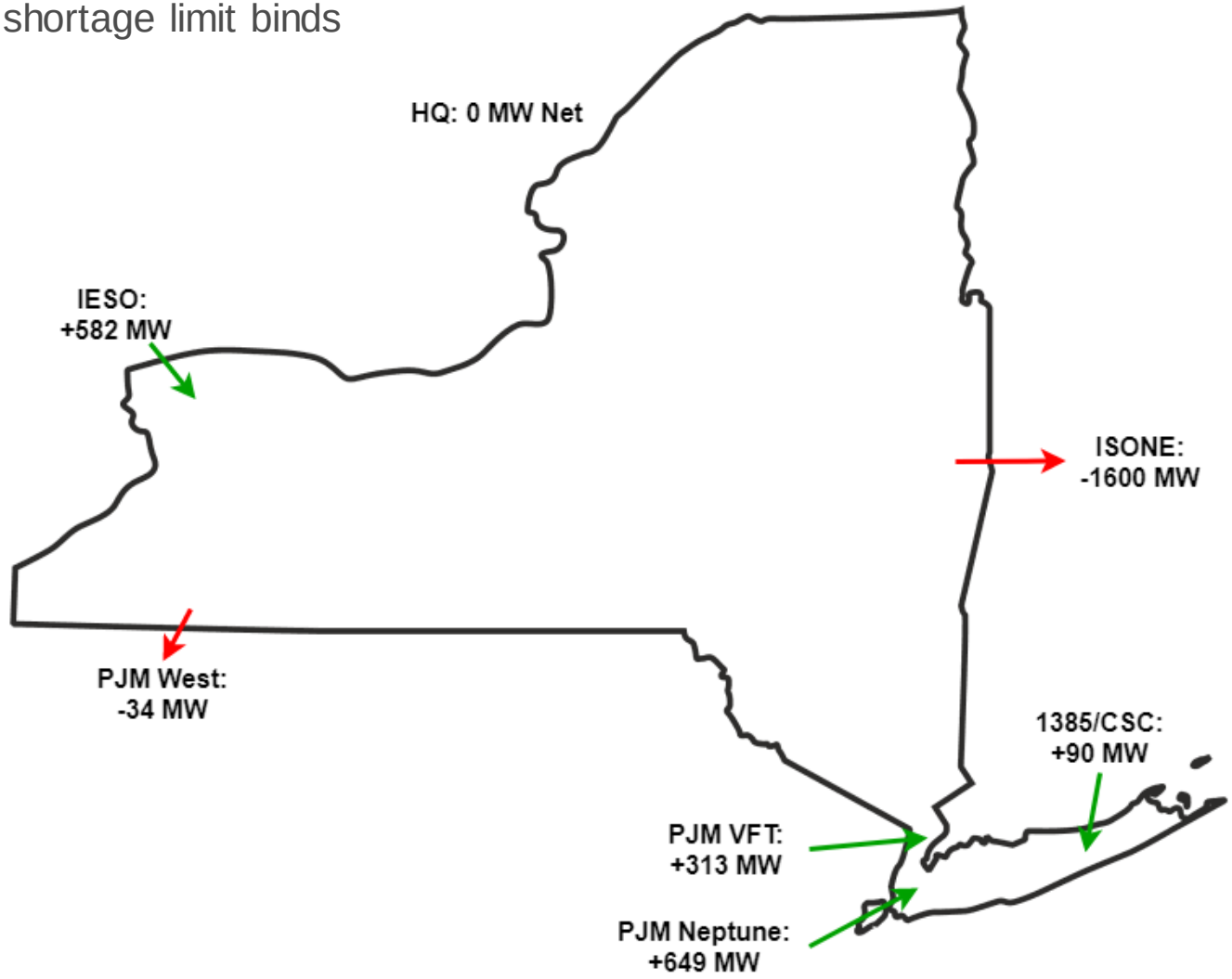
Load vs Temperature during 17 Day Modeled Period



Notes:
[1] Weekends are shaded in gray.
[2] Effective degree day is defined as 65 degrees F - Temperature.
Source:
[1] NYISO Weather and Load Data 1993-2018.

Assumed Energy Imports/Exports during Modeling Period

- Imports/exports fixed with 0 MW net interchange between neighboring regions unless reserve shortage limit binds



Electrical Demand, Supply, and Reserves

- Assumptions regarding simple cycle gas turbine deactivations in response to the proposed NYSDEC "peaker rule"
  - Initial Scenario case would model all peakers in-service
  - Additional Scenario case(s) would model the amount of peakers in-service consistent with the findings of the 2019-2028 Comprehensive Reliability Plan (CRP) "peaker scenario" where compensatory MW would be needed in J and K
    - This scenario was reviewed at the March 19, 2019 ESPWG/TPAS meeting
- Resource capability derates applied during the 17-day modeling period based on historical data from NYISO
- Transmission Limits between regions based on N-1-1 contingency analysis will include new WNY and AC Transmission projects unless otherwise indicated by a particular scenario.

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Combination Cases

- Develop a manageable set of cases to run and evaluate
- Goal – capture a plausible range of futures, and a representative set of extreme events to "bookend" results
- Plan is to start with an extreme scenario where there is a fuel security problem, then back off extreme assumptions to find the minimum set of assumptions where a problem exists
- The following list represents an initial set of possible assumptions; as cases are run, others may need to be developed if gaps in the assessment are identified

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Options for Alternative Assumptions and Scenarios

Case	Weather/Load	Infrastructure	Fuel	Other Scenarios
Variations, Contingencies	**HL:** High Load (+10% LDC & Electric) **LL:** [Recommend evaluating whether a low load/high EE/low LDC demand case is likely to provide meaningful information after initial runs are completed]	**FO:** 10% higher forced outage rate than based on historical data **RE:** Higher intermittent renewable resources w/ non-gas retirements **TR:** WNY and AC transmission lines delayed **PK:** "Peaker scenario" changes	**LFR:** Limited barge or truck fuel delivery based on historical events such as NYC rivers freezing or snow storms **SFR:** "Severe" fuel limitation affecting both barge and truck refueling **NG:** No gas-fired generation capability available (downstate, state-wide)	**NU:** Loss of major nuclear unit upstate **OF:** Loss of major oil-fired generation downstate **PL:** Loss of major interstate pipeline capacity for generation due to: • Pipe failure • Compressor failure • Replacement for loss of LNG or gas storage facility
Initial Cases: V1-12 (Individual Cases)	**HL (V1), LL (V2)**	**FO (V3), RE (V4), TR (V5), PK (V6)**	**LFR (V7), SFR (V8), NG (V9)**	**NU (V10), OF (V11), PL(V12)**
(Combination Cases) C1: Extreme Weather	**HL**	**FO**	**LFR**	
C2: Extreme Weather + Outages	**HL**	**FO**	**SFR**	**NU, OF**
C3: High Renewables + Extreme Weather	**HL**	**RE**	**SFR**	
C4: High Renewables + Outages	**HL**	**RE**	**SFR**	**NU, OF**
C5: Extreme Weather + Loss of Oil and Pipeline	**HL**		**SFR**	**PL**
C6: High Renewables + Loss of Oil, Pipeline and Outages		**RE**	**SFR**	**NU, PL**
C7: Loss of Gas + Outages	**HL**		**NG**	**NU, OF**
C8: Extreme case	**HL**	**FO, TR, PK**	**NG, SFR**	**NU, OF, PL**

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Next Steps

- Tentative Schedule
  - May 2019: AG presentation of initial fuel security analysis findings
  - June 2019: AG presentation of additional findings
  - July 2019: AG presentation of final findings

Contact

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