

## AGENDA

» Weather Trends

- Monthly Cooling Degree Days (CDD) and Heating Degree Days (HDD)
- Peak-day weather variable using a three-day heat index of temperature and humidity (peak-day CTHI)
» Review Modeling Approach
» Preliminary Baseline Results


## WEATHER TRENDS

## TEMPERATURE TRENDS

» Average temperature in New York has been increasing since the early 90 's.

- On average, average annual daily temperatures have been increasing 0.7 degrees per decade
- The coldest day temperatures have been increasing faster than average daily temperature
- Temperatures on the hottest days have been increasing slower than the average daily temperature
» The number of CDD in the shoulder months are increasing faster than in the peak months
» The exception is on Long Island where temperatures on the hottest days are increasing faster than on the average day


## WEATHER TREND ANALYSIS

- Trend analysis on six weather concepts:
- Average annual temperature (avg)
- Average annual temperature for the coldest day (min)
- Average annual temperature for the hottest day (max)
- Annual cumulative temperature humidity index (CTHI) for the hottest day
- Heating degree days
- Cooling degree days
- Processed weather data by weather station:
- 21 weather stations
- Trends developed for each Transmission Operator (TO) based on weather station weighting.
- Daily \& hourly temperature data back to 1950
- Increasing temperature trend beginning in 1992
- Strong statistical support with trend highly significant
- Trend analysis also provides uncertainty bandwidths
- In addition to the trend temperature forecast, a more extreme weather scenario will also be constructed


## TREND MODELS



AvgAvgDB $=f($ Trend, Constant $)$
One model for each of the 6 weather concepts and for each of the operating companies

Estimated from 1950 through 2018


## ALBANY AVERAGE DAILY TEMPERATURE TREND

90\% Confidence
Interval


## ALBANY MAX AND MIN TEMPERATURE TRENDS




Average temperature on coldest days. Temperature increasing 1.5 degrees per

## ALBANY HOT-DAY CUMULATIVE TEMPERATURE HUMIDITY INDEX (CTHI)



Cumulative THI drives summer peak demand. Cumulative THI increases 0.63 degrees per decade.

## NYC AVERAGE DAILY TEMPERATURE TREND



Note: Average daily temperature does not account for humidity or for heat that accumulates over several days in a row.

## NYC MAXIMUM AND MINIMUM TEMPERATURE TREND



Coldest day temperature increase
0.7 degrees per decade

Climate Study Overview 11

## NYC HOT-DAY CUMULATIVE THI



Average peak-producing weather variables increase 0.5 degrees per decade. $10 \%$ probability peak-producing weather increases 0.7 degrees per decade.

## WEATHER TREND COEFFICIENTS

» Average, Max, Min, and CTHI trends estimated for each weather station

- 21 weather stations
» Station trends weighted to TO based on NYISO station weights

| TO | AvgTemp | MaxTemp | MinTemp | CTHI |
| :--- | ---: | ---: | ---: | ---: |
| NIMO | 0.71 | 0.52 | 1.07 | 0.64 |
| ConEd | 0.69 | 0.56 | 0.86 | 0.59 |
| Cen Hudson | 0.90 | 0.78 | 1.78 | 0.80 |
| LIPA | 0.85 | 0.93 | 0.79 | 0.75 |
| NYSEG | 0.60 | 0.44 | 1.07 | 0.55 |
| O \& R | 0.59 | 0.41 | 0.99 | 0.64 |
| RG\&E | 0.78 | 0.45 | 1.12 | 0.68 |
| NYCA | $\mathbf{0 . 7 1}$ | $\mathbf{0 . 5 8}$ | $\mathbf{0 . 9 8}$ | $\mathbf{0 . 6 3}$ |

» State average temperature trend is 0.71 degrees per decade
» Cumulative hot-day CTHI trend is 0.63 degrees per decade

## THE CHALLENGE

» Developing a forecasted weather series that reflects historical weather trends

- Minimum increasing faster than average temperature
- Maximum increasing slower than average temperature
» Faster increase in CDD in the shoulder months
- Summer is coming earlier and staying around longer


## START OFF WITH A DAILY WEATHER PATTERN

1. For AvgDB and CTHI, calculate average by date from $1 / 1 / 1999$ to $12 / 31 / 2018$
a) Average all January $1^{\text {st }}$
b) Average all January $2^{\text {nd }}$
c) ... (all other days in the year)
d) Average all December $31^{\text {st }}$
2. Assign the values to a realistic pattern that assures that the peak-producing weather conditions occur on a weekday


## Calculate Starting Annual Temperature Duration Curve (TDC)

» Sort from high to low temperature and average by season (1999-2018)
» Adjust starting temperature duration curve to 2019 start-year

- Already 20 years out from the starting point
» This is the base. The duration curve adjusted going forward by trend parameters. Similar curve constructed for CTHI.



## Depiction of Adjustment Process - Trend 2050



## TRENDED TEMPERATURE PROJECTIONS

» Map duration curves to the normal temperature pattern

- Rotate by day - always put the hottest on a specified weekday
- Rotate by calendar - always start on January 1st



## CALCULATE DAILY DEGREE-DAYS



## AGGREGATE TO MONTHLY DEGREE DAYS SALESIENERGY WEATHER DRIVERS

» State level

- Average daily temperature increases 0.71 degrees per decade
- Highest daily average temperature increases 0.58 degrees per decade
- Lowest daily average temperature increase 0.91 degrees per decade


Results in 0.8\% annual increase in CDD with a faster increase in May than July


And 0.5\% annual decrease in HDD

## PEAK WEATHER DRIVERS

» CTHI increases 0.63 degrees per decade



Peak TDD (CTHI based degree days) increases $0.3 \%$ degrees per year

Peak-day HDD decreases 0.3\%
degrees per year

## WEATHER TRENDS BY TO

## Peak-Day TDD65

| Year | CenHud | ConEd | LIPA | NIMO | NYPA | NYSEG | OR | RGE | NYCA |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| 2020 | 14.2 | 16.8 | 15.8 | 11.9 | 12.0 | 11.5 | 13.9 | 12.5 | 13.9 |
| 2030 | 14.8 | 17.3 | 16.8 | 12.2 | 12.4 | 11.8 | 14.4 | 12.9 | 14.5 |
| 2040 | 15.5 | 17.9 | 17.7 | 12.6 | 12.8 | 12.1 | 14.9 | 13.3 | 15.0 |
| 2050 | 16.1 | 18.4 | 18.7 | 13.0 | 13.2 | 12.5 | 15.4 | 13.7 | 15.5 |
| Avg Change | $0.44 \%$ | $0.32 \%$ | $0.56 \%$ | $0.32 \%$ | $0.31 \%$ | $0.26 \%$ | $0.35 \%$ | $0.30 \%$ | $0.37 \%$ |

* Derived from trended cumulative peak-day THI


## CDD65

| Year | CenHud | ConEd | LIPA | NIMO | NYPA | NYSEG | OR | RGE | NYCA |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| 2020 | 839.9 | $1,185.2$ | $1,009.6$ | 613.0 | 471.8 | 571.6 | 778.4 | 644.0 | 850.6 |
| 2030 | 925.9 | $1,263.2$ | $1,125.7$ | 669.1 | 497.1 | 616.4 | 827.0 | 700.7 | 919.6 |
| 2040 | $1,020.9$ | $1,349.9$ | $1,253.3$ | 731.8 | 526.4 | 666.9 | 882.0 | 765.2 | 995.9 |
| 2050 | $1,114.2$ | $1,432.0$ | $1,378.6$ | 792.7 | 552.9 | 714.8 | 933.7 | 827.6 | $1,069.5$ |
| Avg Change | $0.95 \%$ | $\mathbf{0 . 6 3 \%}$ | $\mathbf{1 . 0 4 \%}$ | $\mathbf{0 . 8 6 \%}$ | $\mathbf{0 . 5 3 \%}$ | $\mathbf{0 . 7 5 \%}$ | $\mathbf{0 . 6 1 \%}$ | $\mathbf{0 . 8 4 \%}$ | $\mathbf{0 . 7 7 \%}$ |

* Derived from trended temperatures


## MODELING APPROACH

## ENERGY \& PEAK MODELING APPROACH

- Models
- Bottom-up for the state starting with customer class sales
- Top-level for the Transmission Owners - directly modeling system energy and peak demand
- Weather
- Actual daily temperature combined with trended daily temperature
- Actual daily CTHI combined with trended CTHI
- Weather data use to generate monthly CDD, HDD, and peak-day CTHI
- Economic Index
- TO Models: GDP and Households (equally weighted)
- Residential: Households, household income
- Commercial: GDP and nonmanufacturing employment
- Industrial: Industrial output
- Energy Intensity Indices - Heating, Cooling, Base or Non-Weather Sensitive
- Derived from the AEO 2019 end-use forecast for mid-Atlantic
- Weighted to reflect residential, nonresidential sales mix
- For ConEd, modified to reflect higher multi-family mix


## TOP-LEVEL ENERGY MODEL VARIABLES ConEdIson




## ENERGY MODEL - ConEdison

## ESTIMATED JAN 2009 TO DEC 2018

| Variable | Coefficient | StdErr | T-Stat | P-Value |
| :--- | ---: | ---: | ---: | ---: |
| mEnergyVars.XOther | 5191408.895 | 21655.977 | 239.722 | $0.00 \%$ |
| mEnergyVars.XCool | 7485462.138 | 107387.356 | 69.705 | $0.00 \%$ |
| mEnergyVars.XHeat | 2007348.232 | 107838.143 | 18.614 | $0.00 \%$ |
| AR(1) | 0.449 | 0.084 | 5.349 | $0.00 \%$ |



| Model Statistics | 8 |
| :--- | ---: |
| Iterations | 119 |
| Adjusted Observations | 115 |
| Deg. of Freedom for Error | 0.987 |
| R-Squared | 0.986 |
| Adjusted R-Squared | 22.625 |
| AIC | 22.718 |
| BIC | \#NA |
| F-Statistic | \#NA |
| Prob (F-Statistic) | $-1,511.04$ |
| Log-Likelihood | $54,769,366,150,695.20$ |
| Model Sum of Squares | $745,179,363,979.33$ |
| Sum of Squared Errors | $6,479,820,556.34$ |
| Mean Squared Error | $80,497.33$ |
| Std. Error of Regression | $60,644.01$ |
| Mean Abs. Dev. (MAD) | $1.18 \%$ |
| Mean Abs. \% Err. (MAPE) | 1.991 |
| Durbin-Watson Statistic |  |

## PEAK MODEL VARIABLES - ConEdIson




## PEAK MODEL ConEdISON ESTIMATED JAN 2009 TO DEC 2018

| Variable | Coefficient | StdErr | T-Stat | P-Value |
| :--- | ---: | ---: | ---: | ---: |
| mPeakVars.HeatVar | 33.211 | 2.427 | 13.683 | $0.00 \%$ |
| mPeakVars.CoolVar | 256.994 | 10.445 | 24.604 | $0.00 \%$ |
| mPeakVars.BaseMW | 1.265 | 0.009 | 141.703 | $0.00 \%$ |
| mPeakVars.MarBase | -0.037 | 0.014 | -2.616 | $1.02 \%$ |
| mPeakVars.MayBase | 0.114 | 0.018 | 6.363 | $0.00 \%$ |
| mPeakVars.JunBase | 0.176 | 0.023 | 7.727 | $0.00 \%$ |
| mPeakVars.JulBase | 0.151 | 0.028 | 5.436 | $0.00 \%$ |
| mPeakVars.AugBase | 0.143 | 0.025 | 5.798 | $0.00 \%$ |
| mPeakVars.SepBase | 0.179 | 0.024 | 7.468 | $0.00 \%$ |



| Model Statistics |  |
| :--- | ---: |
|  |  |
| Iterations | 1 |
| Adjusted Observations | 120 |
| Deg. of Freedom for Error | 108 |
| R-Squared | 0.984 |
| Adjusted R-Squared | 0.982 |
| AIC | 11.075 |
| BIC | 11.354 |
| F-Statistic | \#NA |
| Prob (F-Statistic) | \#NA |
| Log-Likelihood | -822.79 |
| Model Sum of Squares | $379,927,998.69$ |
| Sum of Squared Errors | $6,342,246.24$ |
| Mean Squared Error | $58,724.50$ |
| Std. Error of Regression | 242.33 |
| Mean Abs. Dev. (MAD) | 182.02 |
| Mean Abs. \% Err. (MAPE) | $1.86 \%$ |
| Durbin-Watson Statistic | 2.049 |

## PRELIMINARY TO DEMAND FORECAST <br> COINCIDENT PEAK UNADJUSTED FOR NEW TECHNOLOGIES

| Year | CenHud |  | ConEd |  | LIPA |  | NGRID |  | NYPA |  | NYSEG |  | OR |  | RGE |  | NYCA |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 2019 | 1,146 |  | 12,938 |  | 5,288 |  | 6,975 |  | 398 |  | 3,153 |  | 1,093 |  | 1,526 |  | 33,203 |  |
| 2020 | 1,146 | 0.0\% | 12,910 | -0.2\% | 5,290 | 0.0\% | 6,953 | -0.3\% | 394 | -0.9\% | 3,143 | -0.3\% | 1,102 | 0.8\% | 1,528 | 0.1\% | 33,282 | 0.2\% |
| 2021 | 1,145 | -0.1\% | 12,853 | -0.4\% | 5,283 | -0.1\% | 6,918 | -0.5\% | 387 | -1.8\% | 3,124 | -0.6\% | 1,108 | 0.5\% | 1,525 | -0.2\% | 33,228 | -0.2\% |
| 2022 | 1,153 | 0.7\% | 12,887 | 0.3\% | 5,314 | 0.6\% | 6,939 | 0.3\% | 384 | -0.9\% | 3,129 | 0.2\% | 1,121 | 1.2\% | 1,535 | 0.6\% | 33,385 | 0.5\% |
| 2023 | 1,159 | 0.5\% | 12,931 | 0.3\% | 5,339 | 0.5\% | 6,953 | 0.2\% | 383 | -0.2\% | 3,133 | 0.1\% | 1,133 | 1.1\% | 1,543 | 0.5\% | 33,494 | 0.3\% |
| 2024 | 1,164 | 0.4\% | 12,968 | 0.3\% | 5,364 | 0.5\% | 6,960 | 0.1\% | 380 | -0.6\% | 3,133 | 0.0\% | 1,146 | 1.1\% | 1,549 | 0.4\% | 33,595 | 0.3\% |
| 2025 | 1,169 | 0.4\% | 13,007 | 0.3\% | 5,389 | 0.5\% | 6,966 | 0.1\% | 378 | -0.6\% | 3,132 | 0.0\% | 1,157 | 1.0\% | 1,554 | 0.3\% | 33,689 | 0.3\% |
| 2026 | 1,172 | 0.3\% | 13,024 | 0.1\% | 5,411 | 0.4\% | 6,961 | -0.1\% | 375 | -0.9\% | 3,126 | -0.2\% | 1,167 | 0.8\% | 1,558 | 0.2\% | 33,762 | 0.2\% |
| 2027 | 1,175 | 0.3\% | 13,053 | 0.2\% | 5,436 | 0.5\% | 6,963 | 0.0\% | 372 | -0.8\% | 3,123 | -0.1\% | 1,178 | 0.9\% | 1,562 | 0.3\% | 33,861 | 0.3\% |
| 2028 | 1,181 | 0.5\% | 13,105 | 0.4\% | 5,470 | 0.6\% | 6,977 | 0.2\% | 370 | -0.5\% | 3,126 | 0.1\% | 1,191 | 1.1\% | 1,569 | 0.4\% | 34,006 | 0.4\% |
| 2029 | 1,187 | 0.5\% | 13,169 | 0.5\% | 5,508 | 0.7\% | 6,997 | 0.3\% | 369 | -0.2\% | 3,131 | 0.2\% | 1,205 | 1.2\% | 1,576 | 0.5\% | 34,173 | 0.5\% |
| 2030 | 1,191 | 0.3\% | 13,163 | 0.0\% | 5,520 | 0.2\% | 6,996 | 0.0\% | 366 | -0.8\% | 3,128 | -0.1\% | 1,216 | 0.9\% | 1,580 | 0.2\% | 34,255 | 0.2\% |
| 2031 | 1,194 | 0.3\% | 13,168 | 0.0\% | 5,536 | 0.3\% | 7,000 | 0.1\% | 364 | -0.7\% | 3,126 | 0.0\% | 1,227 | 0.9\% | 1,584 | 0.3\% | 34,354 | 0.3\% |
| 2032 | 1,199 | 0.3\% | 13,178 | 0.1\% | 5,556 | 0.4\% | 7,007 | 0.1\% | 361 | -0.6\% | 3,126 | 0.0\% | 1,238 | 0.9\% | 1,588 | 0.3\% | 34,458 | 0.3\% |
| 2033 | 1,203 | 0.4\% | 13,199 | 0.2\% | 5,581 | 0.5\% | 7,018 | 0.2\% | 360 | -0.5\% | 3,128 | 0.1\% | 1,250 | 1.0\% | 1,593 | 0.3\% | 34,580 | 0.4\% |
| 2034 | 1,209 | 0.4\% | 13,229 | 0.2\% | 5,610 | 0.5\% | 7,032 | 0.2\% | 358 | -0.4\% | 3,132 | 0.1\% | 1,263 | 1.0\% | 1,599 | 0.4\% | 34,717 | 0.4\% |
| 2035 | 1,214 | 0.5\% | 13,269 | 0.3\% | 5,643 | 0.6\% | 7,050 | 0.3\% | 357 | -0.4\% | 3,136 | 0.2\% | 1,276 | 1.1\% | 1,606 | 0.4\% | 34,872 | 0.4\% |
| 2036 | 1,221 | 0.5\% | 13,321 | 0.4\% | 5,681 | 0.7\% | 7,072 | 0.3\% | 356 | -0.3\% | 3,142 | 0.2\% | 1,290 | 1.1\% | 1,614 | 0.5\% | 35,045 | 0.5\% |
| 2037 | 1,227 | 0.5\% | 13,373 | 0.4\% | 5,719 | 0.7\% | 7,091 | 0.3\% | 354 | -0.4\% | 3,146 | 0.1\% | 1,304 | 1.1\% | 1,621 | 0.4\% | 35,214 | 0.5\% |
| 2038 | 1,233 | 0.5\% | 13,429 | 0.4\% | 5,757 | 0.7\% | 7,111 | 0.3\% | 352 | -0.5\% | 3,150 | 0.1\% | 1,318 | 1.1\% | 1,627 | 0.4\% | 35,385 | 0.5\% |
| 2039 | 1,240 | 0.5\% | 13,488 | 0.4\% | 5,798 | 0.7\% | 7,132 | 0.3\% | 351 | -0.5\% | 3,154 | 0.1\% | 1,332 | 1.1\% | 1,634 | 0.4\% | 35,560 | 0.5\% |
| 2040 | 1,245 | 0.4\% | 13,505 | 0.1\% | 5,822 | 0.4\% | 7,144 | 0.2\% | 348 | -0.8\% | 3,155 | 0.0\% | 1,345 | 0.9\% | 1,639 | 0.3\% | 35,701 | 0.4\% |
| 2041 | 1,250 | 0.4\% | 13,531 | 0.2\% | 5,850 | 0.5\% | 7,156 | 0.2\% | 345 | -0.8\% | 3,155 | 0.0\% | 1,358 | 1.0\% | 1,644 | 0.3\% | 35,847 | 0.4\% |
| 2042 | 1,255 | 0.4\% | 13,561 | 0.2\% | 5,880 | 0.5\% | 7,168 | 0.2\% | 342 | -0.8\% | 3,155 | 0.0\% | 1,371 | 1.0\% | 1,649 | 0.3\% | 35,996 | 0.4\% |
| 2043 | 1,261 | 0.5\% | 13,602 | 0.3\% | 5,913 | 0.6\% | 7,183 | 0.2\% | 339 | -0.8\% | 3,156 | 0.0\% | 1,384 | 1.0\% | 1,655 | 0.3\% | 36,157 | 0.4\% |
| 2044 | 1,268 | 0.5\% | 13,654 | 0.4\% | 5,951 | 0.6\% | 7,202 | 0.3\% | 337 | -0.8\% | 3,158 | 0.1\% | 1,398 | 1.0\% | 1,661 | 0.4\% | 36,337 | 0.5\% |
| 2045 | 1,275 | 0.6\% | 13,720 | 0.5\% | 5,995 | 0.7\% | 7,227 | 0.3\% | 335 | -0.7\% | 3,163 | 0.2\% | 1,414 | 1.1\% | 1,669 | 0.5\% | 36,543 | 0.6\% |
| 2046 | 1,284 | 0.7\% | 13,803 | 0.6\% | 6,046 | 0.9\% | 7,259 | 0.4\% | 333 | -0.5\% | 3,171 | 0.3\% | 1,432 | 1.2\% | 1,678 | 0.6\% | 36,788 | 0.7\% |
| 2047 | 1,293 | 0.7\% | 13,889 | 0.6\% | 6,099 | 0.9\% | 7,293 | 0.5\% | 331 | -0.5\% | 3,180 | 0.3\% | 1,449 | 1.2\% | 1,688 | 0.6\% | 37,037 | 0.7\% |
| 2048 | 1,303 | 0.8\% | 13,985 | 0.7\% | 6,156 | 0.9\% | 7,330 | 0.5\% | 330 | -0.4\% | 3,190 | 0.3\% | 1,468 | 1.3\% | 1,698 | 0.6\% | 37,308 | 0.7\% |
| 2049 | 1,313 | 0.8\% | 14,086 | 0.7\% | 6,216 | 1.0\% | 7,370 | 0.5\% | 328 | -0.4\% | 3,201 | 0.4\% | 1,487 | 1.3\% | 1,709 | 0.7\% | 37,592 | 0.8\% |
| 2050 | 1,324 | 0.8\% | 14,194 | 0.8\% | 6,279 | 1.0\% | 7,413 | 0.6\% | 327 | -0.3\% | 3,214 | 0.4\% | 1,507 | 1.3\% | 1,721 | 0.7\% | 37,891 | 0.8\% |
| 2020-30 |  | 0.4\% |  | 0.2\% |  | 0.4\% |  | 0.1\% |  | -0.7\% |  | 0.0\% |  | 1.0\% |  | 0.3\% |  | 0.29\% |
| 2030-40 |  | 0.4\% |  | 0.3\% |  | 0.5\% |  | 0.2\% |  | -0.5\% |  | 0.1\% |  | 1.0\% |  | 0.4\% |  | 0.41\% |
| 2040-50 |  | 0.6\% |  | 0.5\% |  | 0.8\% |  | 0.4\% |  | -0.6\% |  | 0.2\% |  | 1.1\% |  | 0.5\% |  | 0.60\% |
| 2020-40 |  | 0.5\% |  | 0.3\% |  | 0.6\% |  | 0.2\% |  | -0.6\% |  | 0.1\% |  | 1.0\% |  | 0.4\% |  | 0.4\% |

## ADJUSTING FOR NEW TECHNOLOGIES

» Calculate Baseline Hourly Load Forecast

- Combine peak, energy, and hourly load profile (incorporates increasing temperature
» Generate hourly load forecast for new technologies
- Solar
- Electric Vehicles
- Battery Storage
- Electrification - Heat Pumps, Water Heating, Commercial Cooking, ??
» Calculated Adjusted Hourly Load Profile
- Add EVs and Electrification
- Subtract Solar
» Sum over hours to obtain monthly and annual energy


## LOAD ADJUSTMENT SOLAR, EVS, AND BATTERY




## ADJUSTED LOAD FORECAST




## PEAK COMPARISON

» Baseline Peak Higher than Adjusted Demand through 2033
» Peak demand shifts out two hours by 2022

- Fairly flat system load profile. Doesn't take much to shift demand timing

| Year | Baseline | Time | Adjusted | Time |
| ---: | ---: | ---: | ---: | ---: |
| 2020 | 33,284 | $7 / 15 / 202016: 00$ | 32,722 | $7 / 14 / 202016: 00$ |
| 2030 | 34,256 | $7 / 17 / 203016: 00$ | 33,689 | $7 / 17 / 203018: 00$ |
| 2040 | 35,701 | $7 / 18 / 204016: 00$ | 37,824 | $7 / 18 / 204019: 00$ |
| 2050 | 37,891 | $7 / 20 / 205016: 00$ | 43,709 | $7 / 20 / 205019: 00$ |

## WEATHER IMPACTS

## NYCA COOLING REQUIREMENTS



## NYCA HEATING REQUIREMENTS



## NYCA ENERGY REQUIREMENTS



In total, there is not much of an impact

* Increase in cooling load offset by decrease in heating load
* Heating and cooling are relatively small part of total energy requirements


## SYSTEM END-USE DISTRIBUTION


» Heating and cooling requirements are small compared to total non-weather sensitive usage

## SYSTEM PEAK IMPACT <br> COMPARISON WITH NORMAL PEAK WEATHER



1,326 to 2,653 MW higher by 2040

## SYSTEM PEAK FORECAST WITH 1.4 DEGREE PER DECADE TREND

| Summer Peak Demand |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 45,000 |  |  |  |  |  |  |
| 40,000 |  |  |  |  |  |  |
| $\sum_{30,000}^{35,000}$ |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  | Year | Normal | Trended*2 | Upper (90\%) | Difference | Pct |
| 25,000 | 2020 | 32,950 | 33,791 | 35,114 | 841 to 2,164 | 2.6\% to 6.6\% |
|  | 2030 | 33,451 | 35,251 | 36,576 | 1,800 to 3,125 | 5.4\% to 9.3\% |
|  | 2040 | 34,375 | 37,240 | 38,570 | 2,865 to 4,195 | 8.3\% to $12.2 \%$ |
| 20,000 | 2050 | 35,964 | 40,061 | 41,400 | 4,097 to 5,436 | 11.4\% to $15.1 \%$ |
|  | $\underset{\sim}{\mathbb{N}} \underset{\sim}{N}$ |  |  |  |  |  |

2,865 to 4,195 MW higher by 2040

## SYSTEM HOURLY LOAD PROFILE - 2020



## IMPACT IN HOURLY LOADS OVER TIME DAYS OVER 80 DEGREES AND HOURS OVER 32,000 MW

| Year | Month | DaysOvr80 | Hr10 Plus | Hr11 Plus | Hr12 Plus | Hr13 Plus | Hr14 Plus | Hr15 Plus | Hr16 Plus | Hr17 Plus | Hr18 Plus | Hr19 Plus | Hr20 Plus | Hr21 Plus | Hr22 Plus | Hr23 Plus | Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 2020 | 1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2020 | 2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2020 | 3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2020 | 4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2020 | 5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2020 | 6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2020 | 7 | 5.00 | 0.00 | 0.00 | 1.00 | 2.00 | 3.00 | 3.00 | 4.00 | 3.00 | 2.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 18.00 |
| 2020 | 8 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 4.00 |
| 2020 | 9 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2020 | 10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2020 | 11 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2020 | 12 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |


| Year | Month | DaysOvr80 | Hr10 Plus | Hr11 Plus | Hr12 Plus | Hr13 Plus | Hr14 Plus | Hr15 Plus | Hr16 Plus | Hr17 Plus | Hr18 Plus | Hr19 Plus | Hr 20 Plus | Hr21 Plus | Hr22 Plus | Hr23 Plus | Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 2030 | 1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2030 | 2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2030 | 3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2030 | 4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2030 | 5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2030 | 6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2030 | 7 | 6.00 | 0.00 | 1.00 | 3.00 | 4.00 | 4.00 | 4.00 | 5.00 | 4.00 | 4.00 | 2.00 | 0.00 | 0.00 | 0.00 | 0.00 | 31.00 |
| 2030 | 8 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 1.00 | 1.00 | 2.00 | 1.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 7.00 |
| 2030 | 9 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2030 | 10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2030 | 11 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2030 | 12 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |


| Year | Month | DaysOvr80 | Hr10 Plus | Hr11 Plus | Hr12 Plus | Hr13 Plus | Hr14 Plus | Hr15 Plus | Hr16 Plus | Hr17 Plus | Hr18 Plus | Hr19 Plus | Hr 20 Plus | Hr21 Plus | Hr22 Plus | Hr23 Plus | Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 2040 | 1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2040 | 2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2040 | 3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2040 | 4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2040 | 5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2040 | 6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2040 | 7 | 8.00 | 0.00 | 3.00 | 5.00 | 6.00 | 7.00 | 8.00 | 10.00 | 8.00 | 6.00 | 4.00 | 3.00 | 1.00 | 0.00 | 0.00 | 61.00 |
| 2040 | 8 | 1.00 | 0.00 | 0.00 | 1.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 2.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 19.00 |
| 2040 | 9 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2040 | 10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2040 | 11 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2040 | 12 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## NEXT STEPS

» Evaluate - 90\% weather impacts
» Evaluate load impact for potentially more extreme climate impacts
» Develop load scenarios for state public policy goals

- Solar, Electric Vehicles, Battery Storage, Electrification


## QUESTIONS

