New York ISO
Independent System Operator

Grid in Transition Study: Phase 1 Analysis

Nicole Bouchez, Ph.D.
Principal Economist, Market Design

Michael Ferrari
Market Design Specialist, NRI, Market Design

Vijay Kaki
Market Design Specialist, EMD, Market Design

ICAPWG/MIWG

June 28, 2022

Agenda

- Background, 2022 study deliverable & plan
- Phase 1 Assumptions
- Phase 1 results: leveraging the information in the Climate Change Phase 1 Study and the System and Resource Outlook Policy Case renewable buildouts
  - Load shapes – winter peak, summer peak and shoulder
  - Distributions of hourly ramp needs over the year
  - Multi-hour ramp needs
- Next Steps

Today's Goal: Review the results for Phase 1 of the Grid in Transition Study and get stakeholder feedback.

New York ISO

Background, 2022 study deliverable & plan

Grid in Transition

- **Background:**
  - A rapid transition is underway in New York State from a power grid where energy is largely produced by central-station fossil fuel generation, towards a grid with increased intermittent renewable resources and distributed generation.
  - A grid characterized by high levels of intermittent renewable resources and distributed generation will require new thinking. We approach potential market enhancement efforts with two guiding principles:
    - (1) all aspects of grid reliability must be maintained; and
    - (2) competitive markets should continue to maximize economic efficiency and minimize the cost of maintaining reliability while supporting the achievement of New York's climate policy codified in the CLCPA.
  - The study will inform the NYISO's planning, forecasting, and operations, as well as the development of wholesale market mechanisms to enhance grid resilience.

Excerpted from the August 27 2021 presentation of *2022 Market Project Candidates*
https://www.nyiso.com/documents/20142/24145498/02%20Proposed%202022%20Market%20Project%20Descriptionsl.pdf/1950d339-57d7-7e0d-dcc2-4ac1e6a738bc

Grid in Transition

- **Deliverable: Q4 Study Complete**
- **Project Description:**
  - Using the work completed to date across various NYISO studies and initiatives, including the Reliability and Market Considerations for a Grid in Transition work and Climate Change Study work, the 2022 effort will identify and, if possible, quantify through a new study, the potential level of system flexibility and/or grid attributes needed to reliably maintain system balance.

Excerpted from the August 27 2021 presentation of *2022 Market Project Candidates*
https://www.nyiso.com/documents/20142/24145498/02%20Proposed%202022%20Market%20Project%20Descriptionsl.pdf/1950d339-57d7-7e0d-dcc2-4ac1e6a738bc

Plan

- The study will look at the evolution of the variability that dispatchable generators will face over time to inform upcoming market design decisions: are changes to existing market products needed and/or are new products needed for the reliable operation of the grid?
- The study will
  - Look at evolution of load and net load shapes (load net of wind and solar) over time,
  - Look at the distribution of hourly ramps over time, and
  - Look at periods (multi day) with low wind and solar and what that implies for net energy and hourly ramps.
- Since load forecasts are constantly evolving and being reviewed and since different load forecasts have different implications, the study will leverage different forecasts and their underlying assumptions using data from previous studies.

New York ISO

Multi phase study

- First phase – leverage the Climate Change Phase 1 "CLCPA Case" data to look at the questions
- Second phase – coordinate with 2022 planning studies
  - Leverage the upcoming Outlook study Policy Case and possibly the NYSERDA Integration Analysis: Scenario 2 load forecast case
- See March 3 ICAP/MIWG presentation for additional details

New York ISO

Multi phase study

- First phase – leverage the Climate Change Phase 1 "CLCPA Case" data to look at the questions
- Second phase – coordinate with 2022 planning studies
  - Leverage the upcoming Outlook study Policy Case and possibly the NYSERDA Integration Analysis: Scenario 2 load forecast case
- See March 3 ICAP/MIWG presentation for additional details

The focus is on the variability that dispatchable generation will face

- **Source of variability:**
  - Load
  - Intermittent variable resources
    - Wind- Off Shore Wind (OSW) and Land Based Wind (LBW)
    - Solar- Behind the Meter (BTM) and Front of the Meter (FTM)
  - Charging Storage
- **Dispatchable/flexible resources**
  - Dispatchable fossil (as permitted)
  - Discharging Storage
    - Batteries
    - Pump storage
  - Imports and exports
  - Ponding hydro
  - Price Responsive Load
  - New flexible technology (Dispatchable Emission Free Resources – DEFR)

New York ISO

The focus is on the variability that dispatchable generation will face

- **Source of variability:**
  - Load
  - Intermittent variable resources
    - Wind- Off Shore Wind (OSW) and Land Based Wind (LBW)
    - Solar- Behind the Meter (BTM) and Front of the Meter (FTM)
  - Charging Storage

Focus of study

- **Dispatchable/flexible resources**
  - Dispatchable fossil (as permitted)
  - Discharging Storage
    - Batteries
    - Pump storage
  - Imports and exports
  - Ponding hydro
  - Price Responsive Load
  - New flexible technology (Dispatchable Emission Free Resources – DEFR)

New York ISO

Phase 1 Assumptions

Climate Change Phase 1 "CLCPA Case"

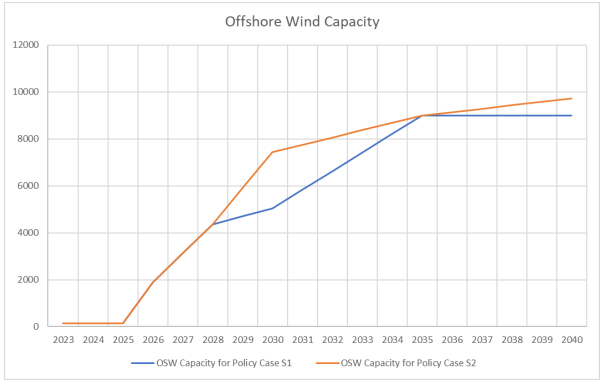
- As discussed in the prior presentations, this phase of the study will be based on the Climate Change Phase 1 CLCPA Case load forecast data. *
- Today's presentation is focused on the hourly variability from:
  - Climate Change Phase 1 load forecast (adjusted for the new 10 GW BTM PV in 2030)
    minus Front of the meter solar output
    minus Off Shore Wind Output
    minus Land Based Wind Output**
- Note that although we will be discussing both ramp up and ramp down instances, most of the intermittent resources are on dispatch and can be ramped down, so we are focusing on the ramp up events.

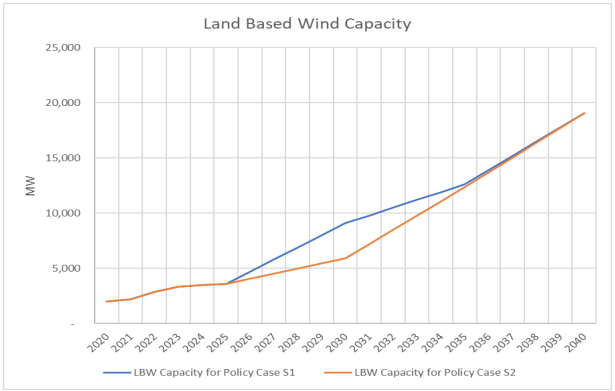
* Climate Change Phase 1 report; **Note that this can result in negative Net Load which may lead to larger than expected ramps. As a complement to this analysis, the NYISO will also look at ramps when Net Load is non-negative.

New York ISO

Assumptions – Wind (LBW and OSW)

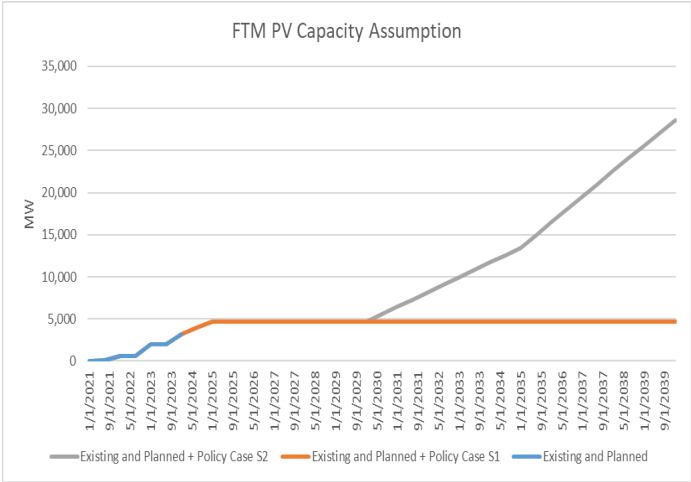
- **Land Based Wind (LBW) & Off Shore Wind (OSW) Capacity**
  - Existing LBW capacity based on the 2021 Gold Book
  - Capacity additions for both Land Based Wind and Offshore Wind were taken from
    - Facilities that have completed Class Year Facilities Study (2021 Gold Book)
    - Facilities that have completed CRIS Request (2021 Gold Book)
    - Future and Non-Class Year Facilities reported to NYSERDA ((https://data.ny.gov/Energy-Environment/Large-scale-Renewable-Projects-Reported-by-NYSERDA/dprp-55ye)
  - Beyond the years reported for entry of these facilities, subsequent additions were determined using linear trends based on System and Resource Outlook Policy Cases S1 and S2 (see the April 26 ESPWG presentation)
- **LBW Shapes - Based on the 2009 Land Based Wind Hourly NREL Data**
- **OSW Shapes -Based on the 2009 Offshore Wind Annual Hourly NREL Data**





Assumptions- Solar (BTM and FTM)

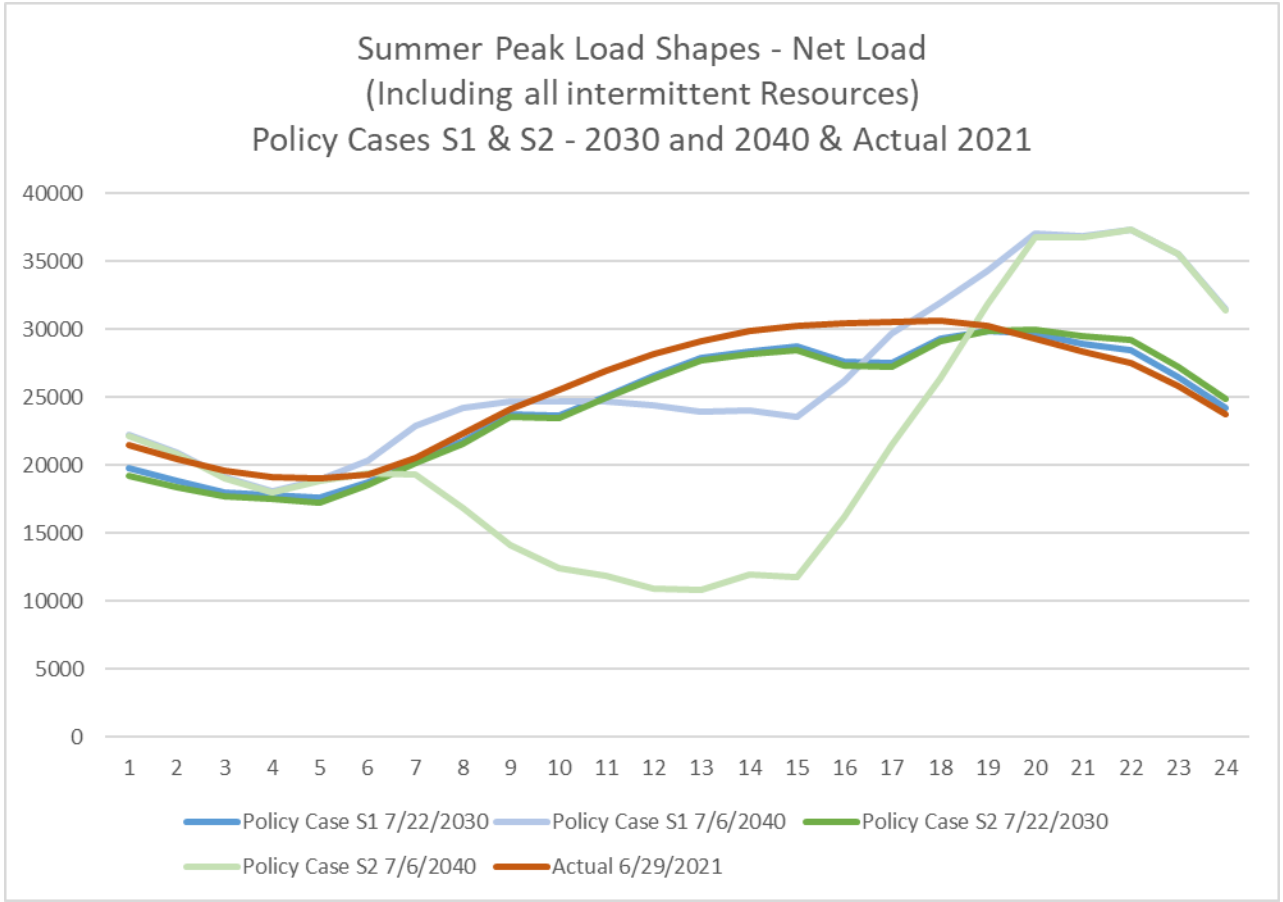
- **BTM PV– increased the Climate Change Phase 1 CLCPA case assumption of 6GW to 10GW consistent with current policy**
  - The existing shape and path of adoption assumed in the Climate Change Phase 1 CLCPA Case maintained until 2025 then scaled to reach 10 GW from 2026 until 2030*
- **FTM PV**
  - Existing and planned capacity based on the installed in-service date provided in the 2021 Gold Book. Approximately 30 MW of existing and planned FTM Solar:
    - Facilities that have completed Class Year Facilities Study (2021 Gold Book)
    - Facilities that have completed CRIS Request (2021 Gold Book)
    - Future and Non-Class Year Facilities Reported to NYSERDA (https://data.ny.gov/Energy-Environment/Large-scale-Renewable-Projects-Reported-by-NYSERDA/dprp-55ye)
  - Beyond 2023 adjusted the assumed MW to be in line with the System and Resource Outlook Study Policy Cases S1 and S2 grid scale solar resources (see the April 26 ESPWG presentation)
  - Using the 2006 Solar Planning Shape for upstate zones and the actual 2019 production data shape for zone K

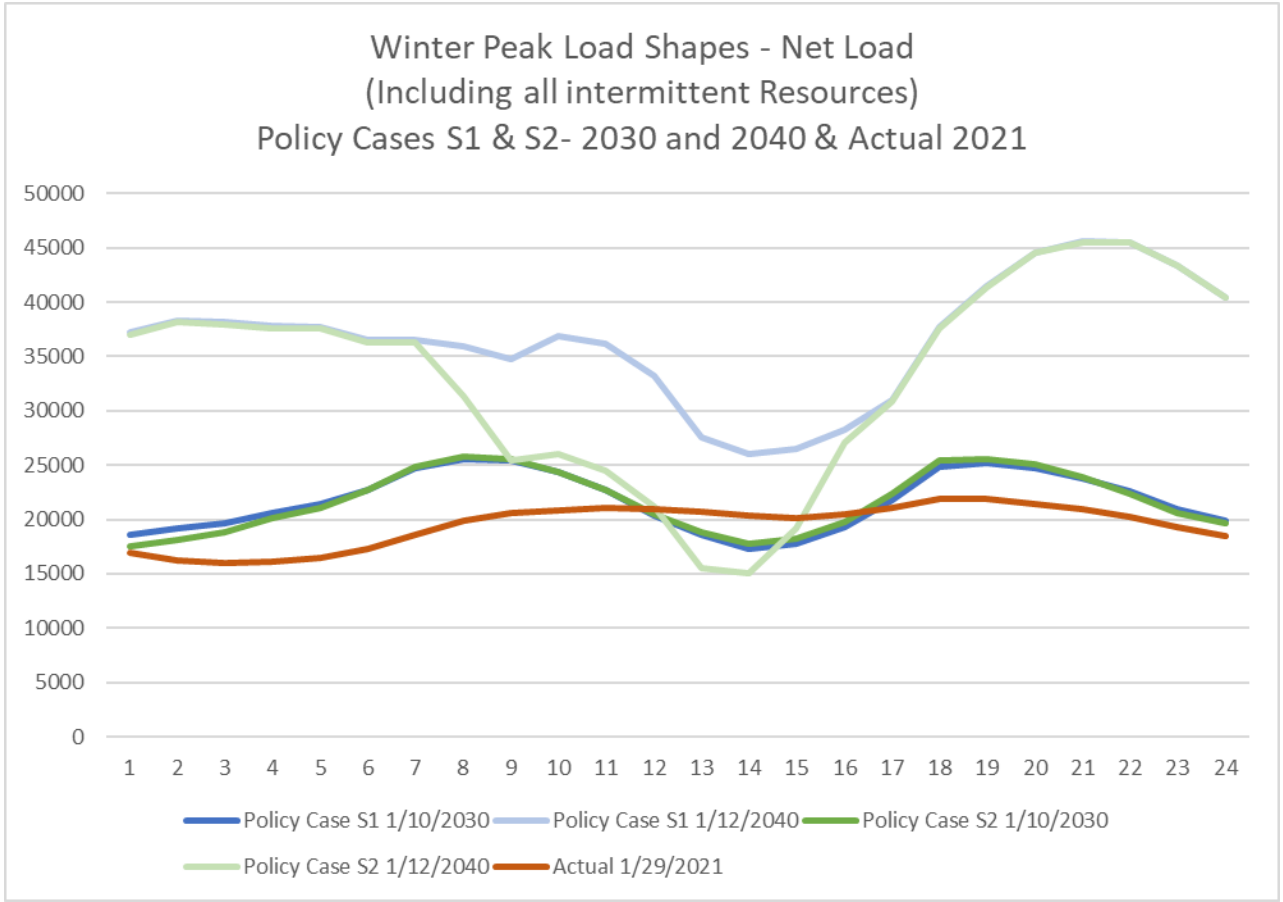


* Updated from last presentation

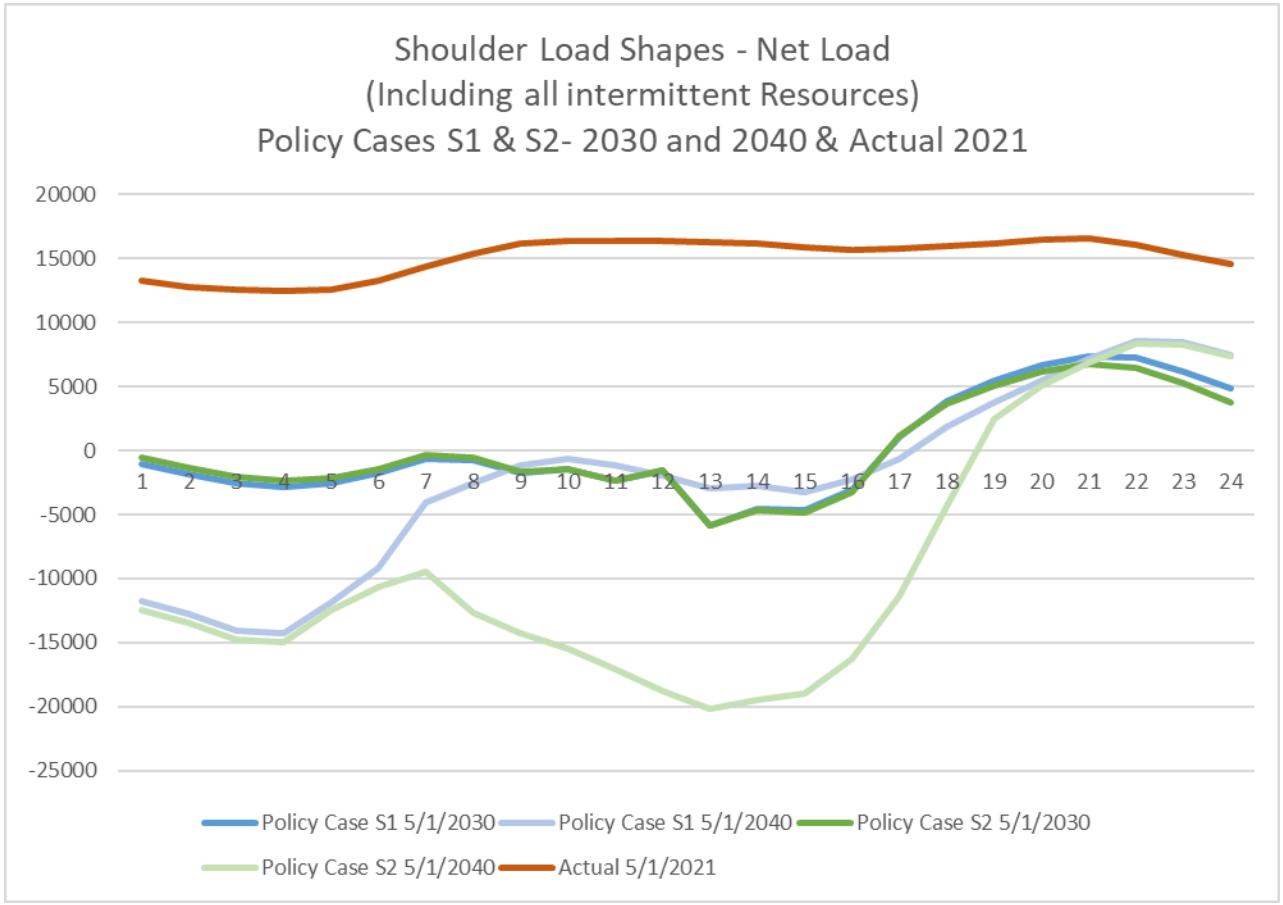
Phase 1 Revised Preliminary Results

Load Shapes – 2030 and 2040 (and actual 2021)

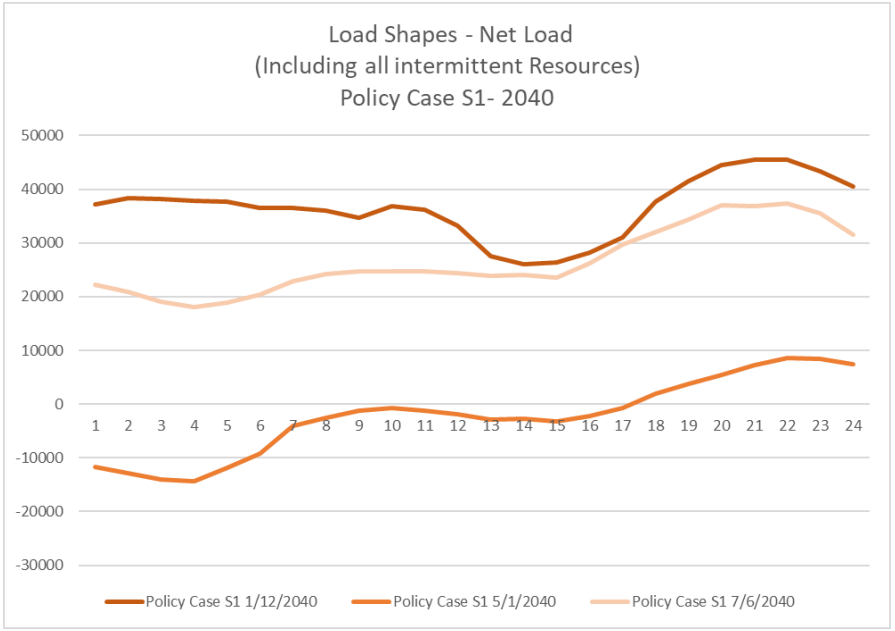


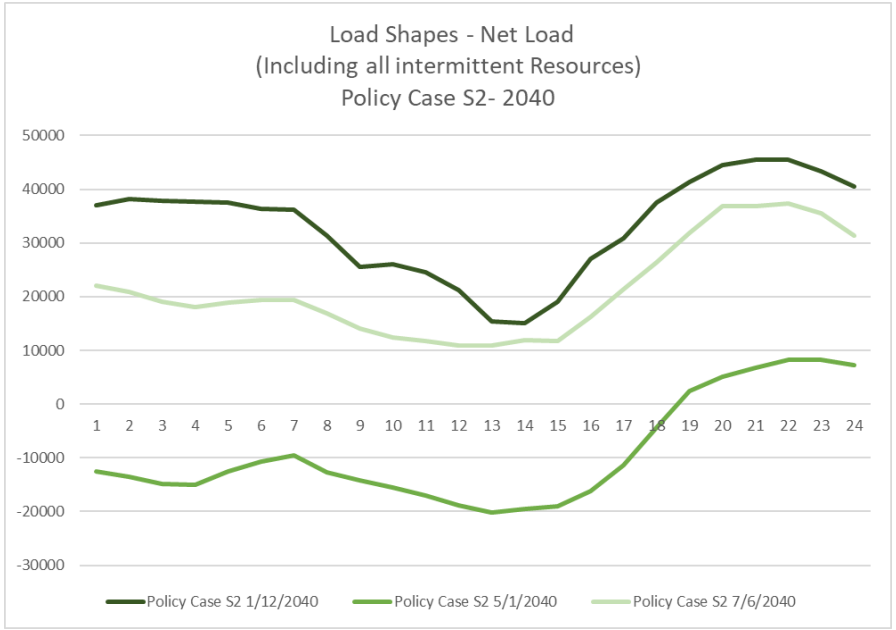


New York ISO



New York ISO





New York ISO

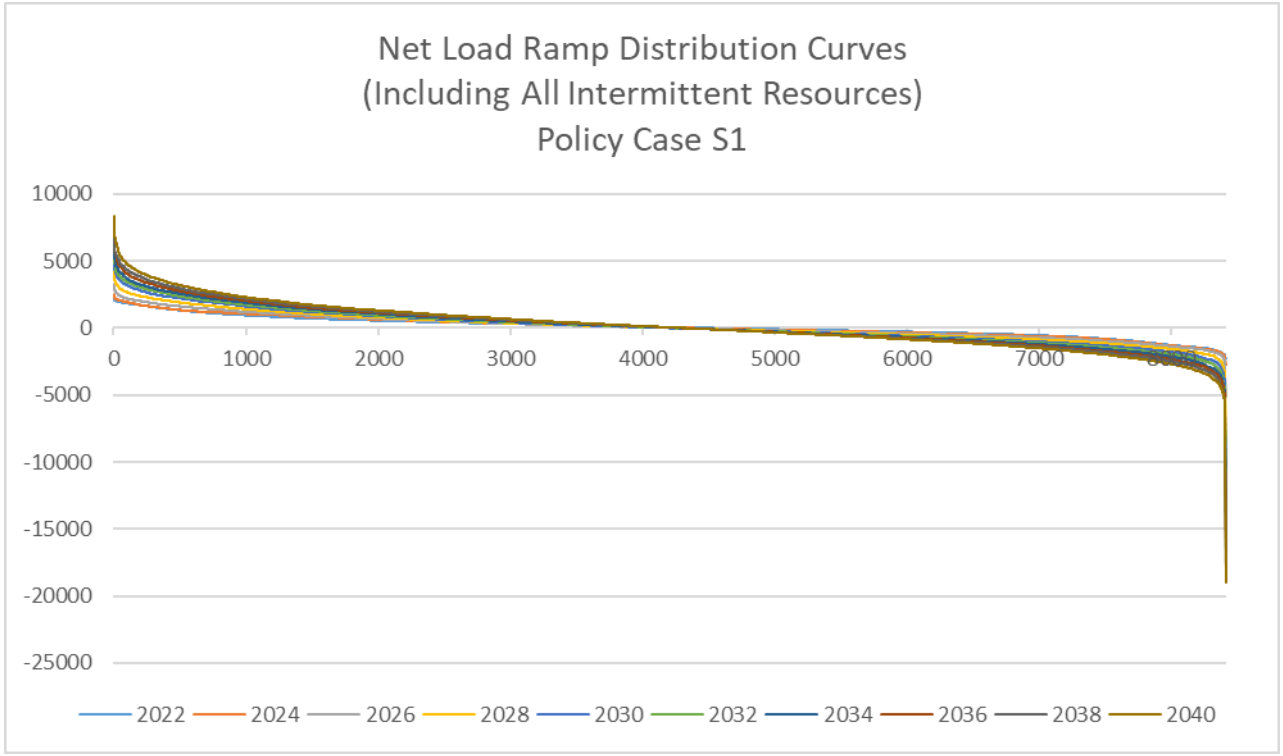
Ramp Distribution Curves

Looking at the hourly ramps over the entire year*

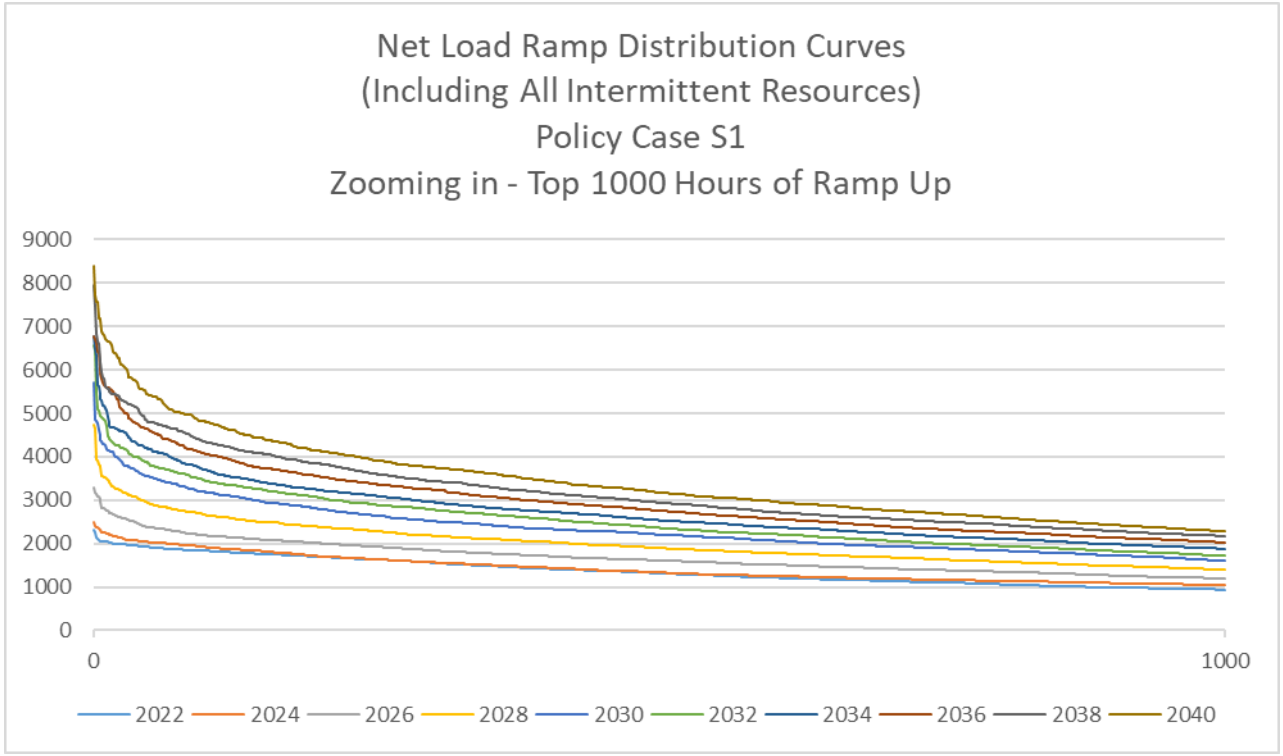
*Note: Does not include the over midnight ramps because of data discontinuities that produce phantom ramps

Policy Case S1

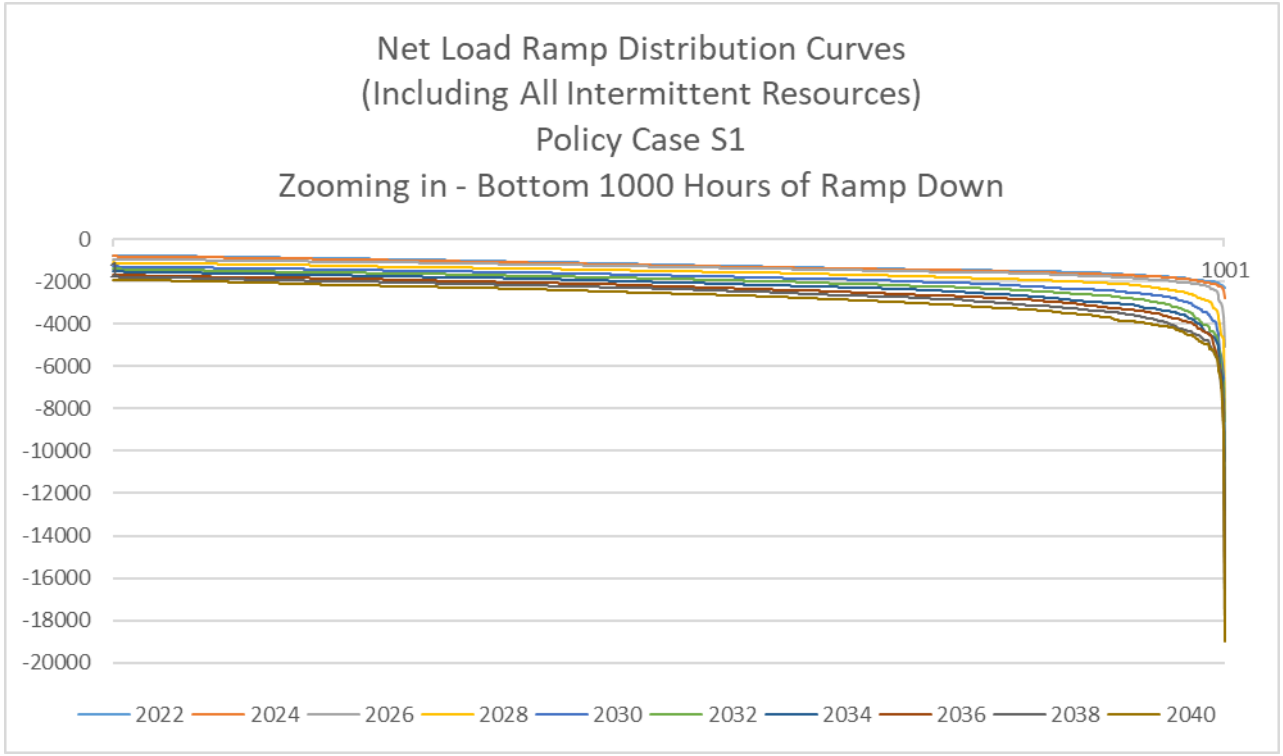
22



New York ISO

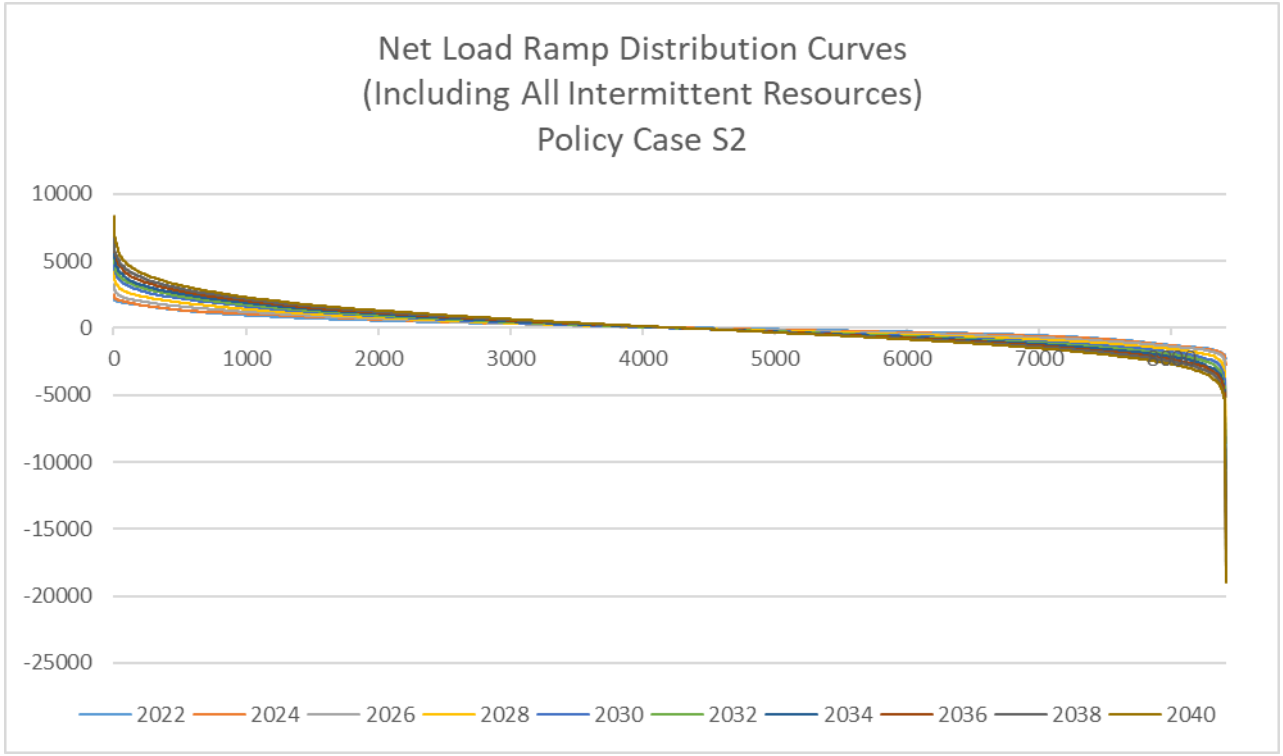


New York ISO

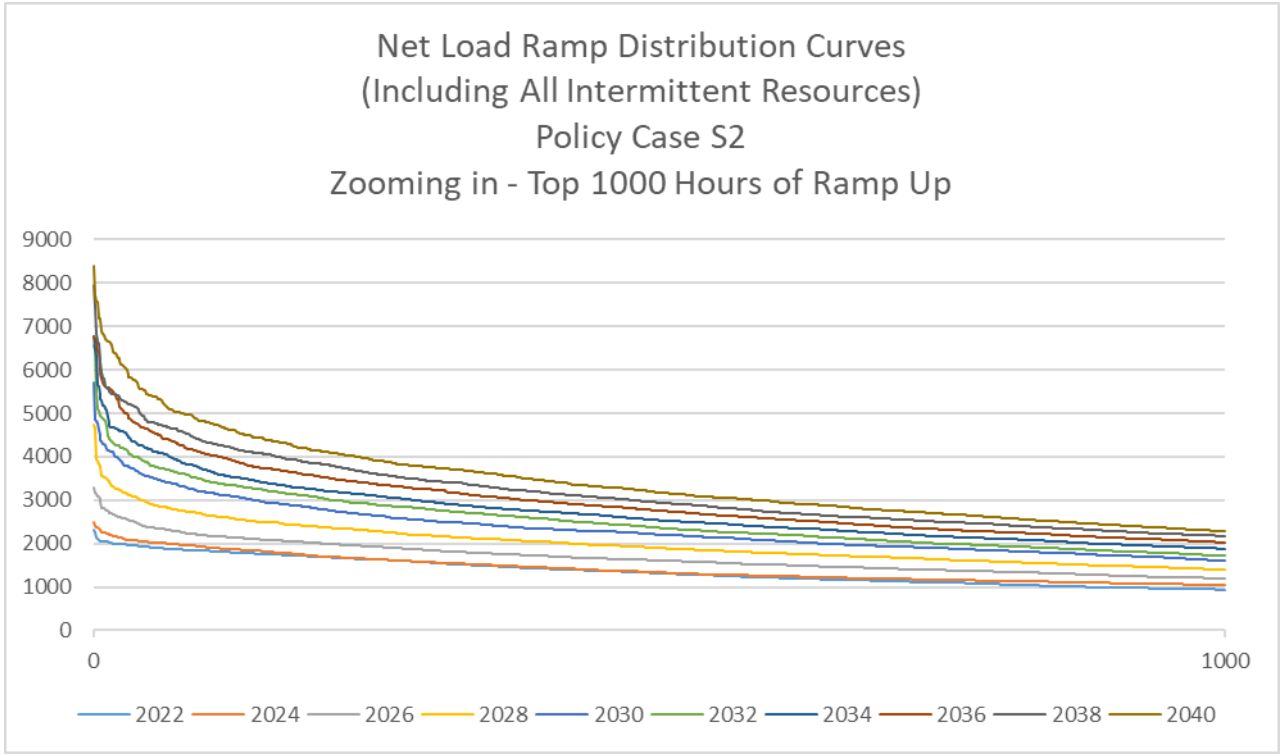


New York ISO

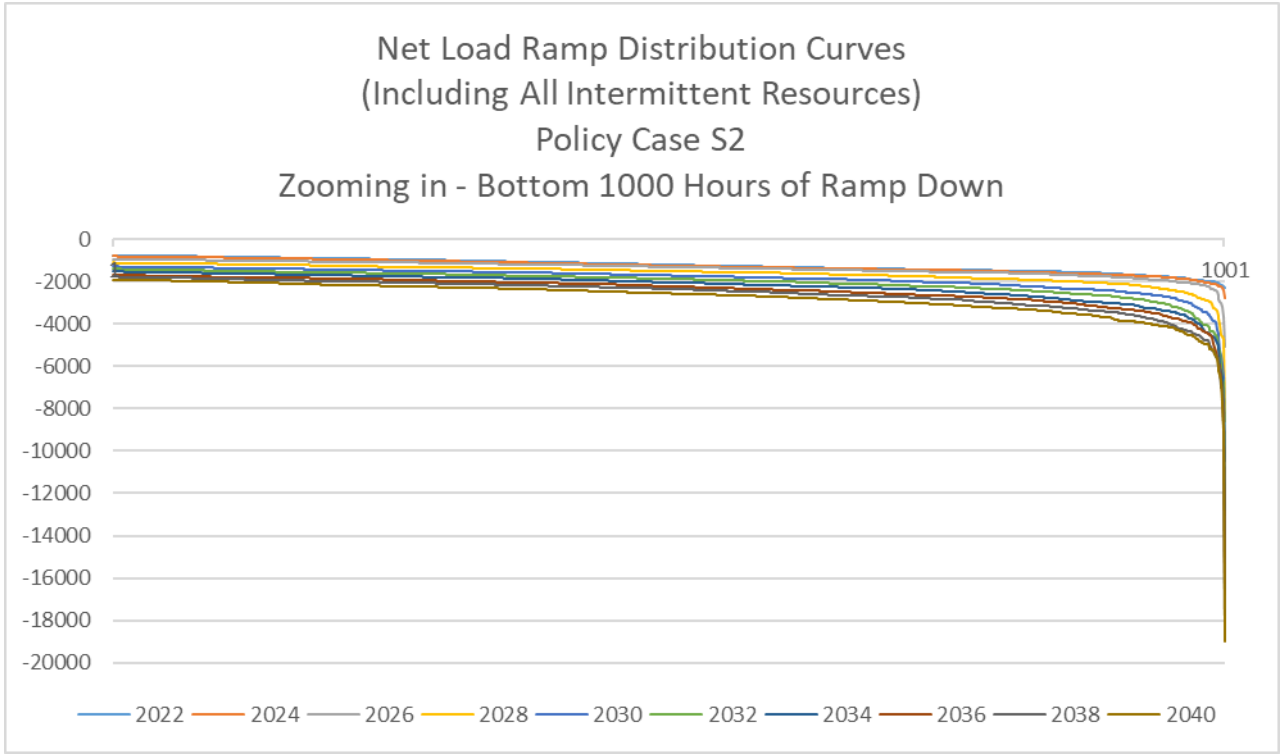
Policy Case S2



New York ISO

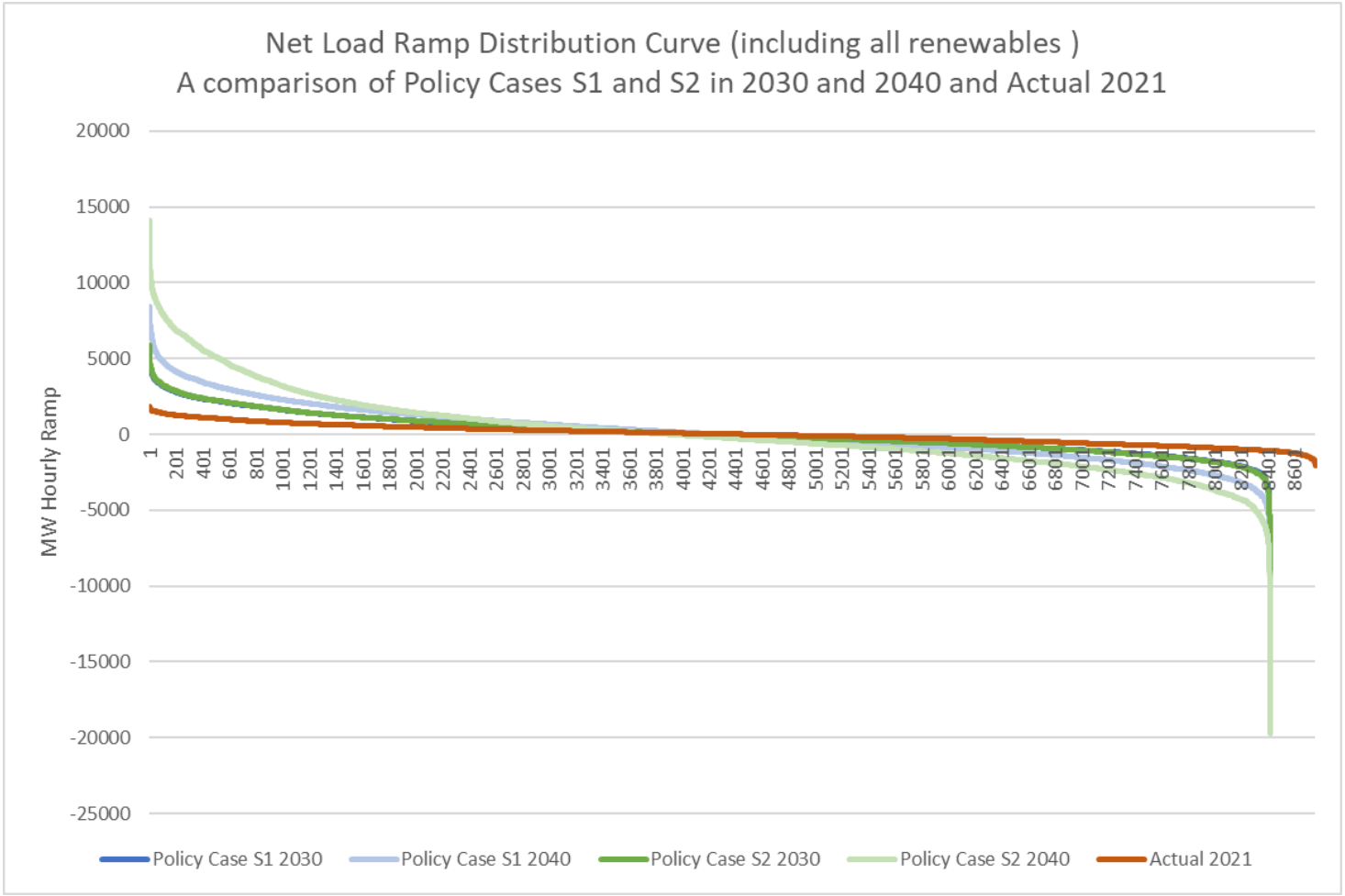


New York ISO



New York ISO

A comparison of Policy Cases S1 & S2



New York ISO

Multi Hour Ramps

Looking at the total multi hour ramps over the entire year*

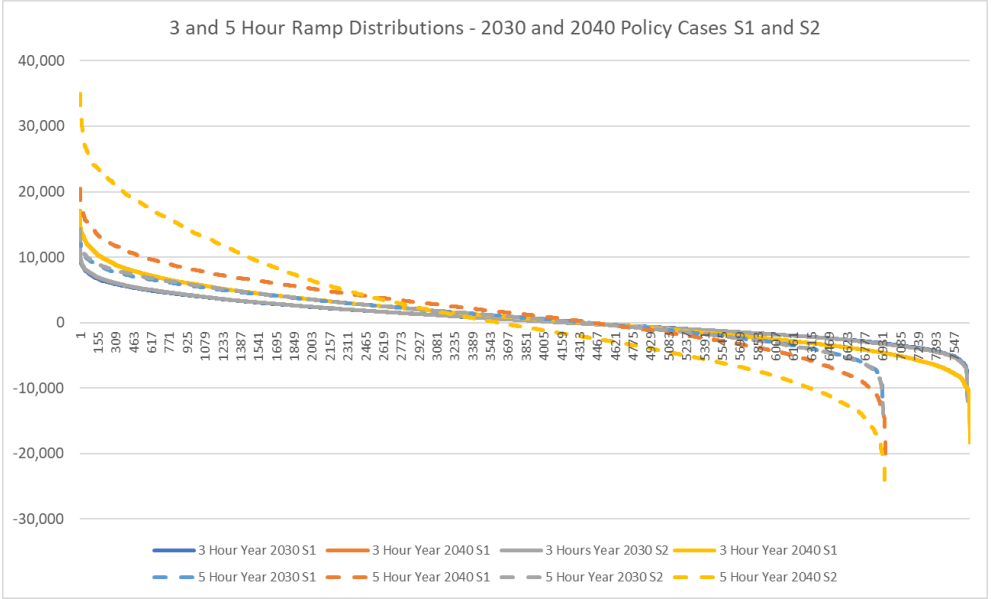
*Note: Does not include the over midnight ramps because of data discontinuities that produce phantom ramps

Multi Hour Ramps

- **Although looking at hourly ramps is very informative, the total ramp up is particularly useful to look at when considering the future needs of the grid**
- **We are looking at several different metrics**
  - The 3 and 5 hour ramping needs – a rolling metric that looks at the in-day net ramp (including all intermittent resources) over 3 and 5 hours.
  - The ramp needs over the entire up or down in-day ramp period
    - For example, if over a 24 hour period the net load ramps down for 6, up for 8 hours, down for 2 then up again for 5 and down for 3 that would be three down ramp events for 6,2, and 3 hours and two up events for 8 and 5 hours.
    - This allows visibility of the full magnitude of ramp up events.

New York ISO

Three and Five Hour Ramps: 2030 and 2040



Ramp	Case	Year	Mean	Median	Standard Deviation	Max Ramp Up	Max Ramp Down
3 Hour	Policy Case S1	2030	552	350	2,915	10,741	-11,330
	Policy Case S2	2030	557	345	2,978	11,788	-11,962
5 Hour	Policy Case S1	2030	1,291	1,261	3,826	13,389	-13,648
	Policy Case S2	2030	1,300	1,274	3,933	14,252	-14,425
3 Hour	Policy Case S1	2040	860	661	4,349	17,036	-18,309
	Policy Case S2	2040	906	-180	6,795	30,315	-15,207
5 Hour	Policy Case S1	2040	1,989	1,970	5,668	20,448	-13,449
	Policy Case S2	2040	2,002	449	9,781	34,903	-20,434

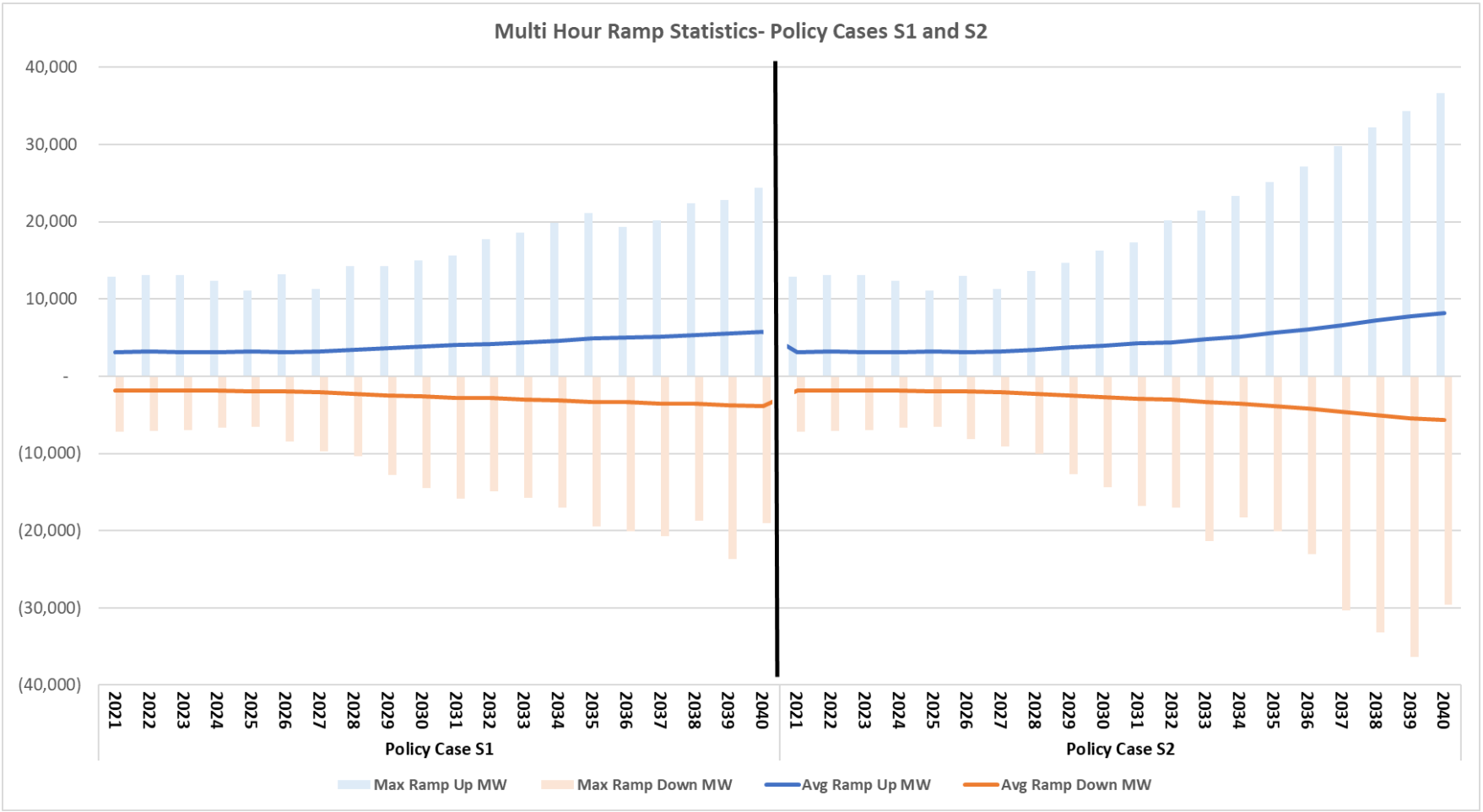
Multi Hour Ramping Needs

- This metric looks at the entirety of the ramp up and ramp down events
- Looking at the years 2022-2040, the averages of the Policy Cases S1 and S2 are fairly close (average ramps of 328MW and 333MW respectively) however the higher amounts of solar resources in Policy Case S2 lead to larger ramp needs in the extremes of the distribution (both ramps up and ramps down). This is consistent with the load shapes and hourly ramp distributions seen earlier.

Summary Statistics- 2022 through 2040

	Year	No. of Instances	Average number of Ramp up hours	Average ramp MWs	25 %ile Ramp MWs	50 %ile / Median Ramp MWs	75 %ile Ramp MWs	Max Ramp Up	Max Ramp Down	Max number of hours	Min number of ramp hours
Policy Case S1	Overall (2022-2040)	46077	3.5	331	-2401	-257	2845	24388	-23631	19	1
Policy Case S2	Overall (2022-2040)	45383	3.5	337	-2635	-287	2505	36692	-36308	17	1

New York ISO



New York ISO

Ramp up needs

- **Focusing on instances when the multi-hour ramp up is greater than 5,000MW and when it is greater than 10,000 MW**
  - Ramp up needs are larger in 2040 than 2030
  - Ramp up needs greater under Policy Case S2 than S1 because of the larger amounts of assumed intermittent resources

Scenario	Year	No. of Instances	Ramp MWs	Average number of Ramp up hours	Average ramp MWs	Shoulder % (6 months)	Winter %	Summer %	25 %ile Ramp MWs	50 %ile / Median Ramp MWs	75 %ile Ramp MWs
Policy Case S1	2030	398	>5000	5.9	7692	48%	28%	24%	6235	7460	8791
Policy Case S1	2040	558	>5000	5.6	10032	49%	26%	25%	6985	9380	12335
Policy Case S2	2030	407	>5000	6.0	7905	49%	28%	23%	6355	7771	9052
Policy Case S2	2040	466	>5000	6.0	17019	50%	28%	21%	10055	17542	22968
Policy Case S1	2030	46	>10000	6.8	11149	59%	37%	4%	10321	10979	11773
Policy Case S1	2040	245	>10000	6.5	13371	45%	32%	23%	11130	12694	15009
Policy Case S2	2030	58	>10000	7.0	11394	59%	29%	12%	10426	10865	11973
Policy Case S2	2040	351	>10000	6.5	20274	50%	25%	25%	15340	20166	24528

New York ISO

Next Steps

Planned Next Steps

- Expand the analysis to look at ramps when Net Load does not become negative
- Consider the feedback from stakeholders on Phase 1
  - We will start to draft the Phase 1 analysis portion of the report.
- Early August - Phase 2 analysis based on the System and Resource Outlook study production cost data (looking at both Policy Cases)
- September - Finalize study

Our Mission & Vision

Mission

Ensure power system reliability and competitive markets for New York in a clean energy future

Vision

Working together with stakeholders to build the cleanest, most reliable electric system in the nation

New York ISO

Questions?