New York ISO
Independent System Operator

Insights from Studying a Dispatchable Emission Free Resource (DEFR)

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Manager, Economic Planning

ESIG Fall 2022 Technical Workshop

Panel on Planning and Deployment Implications with Storage and IBRs

Tuesday, October 25th, 2022

Agenda

- NYISO Planning
- System & Resource Outlook
- Dispatchable Emissions Free Resources (DEFRs)
- Conclusions & Questions

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NYISO System & Resource Planning

The Roles of the NYISO

- **Reliable Operations**
  Maintaining bulk power system reliability is the cornerstone of the NYISO's mission and focus, shaping how we operate, design markets, and conduct system planning.

- **Efficient Markets**
  Competitive wholesale electric markets provide reliable power at the lowest possible cost to meet consumer needs. We conduct and monitor competitive auctions of wholesale electricity including needed ancillary services every five minutes, every day of the year.

- **Comprehensive Planning**
  An important step in supporting New York's ambitious clean energy goals is to study the future grid to promote a better understanding of what will be needed, including emerging technologies, to meet reliability.

- **Authoritative Source**
  A pillar of our focus is to serve as an independent source of fact-based information on the evolving electric system.

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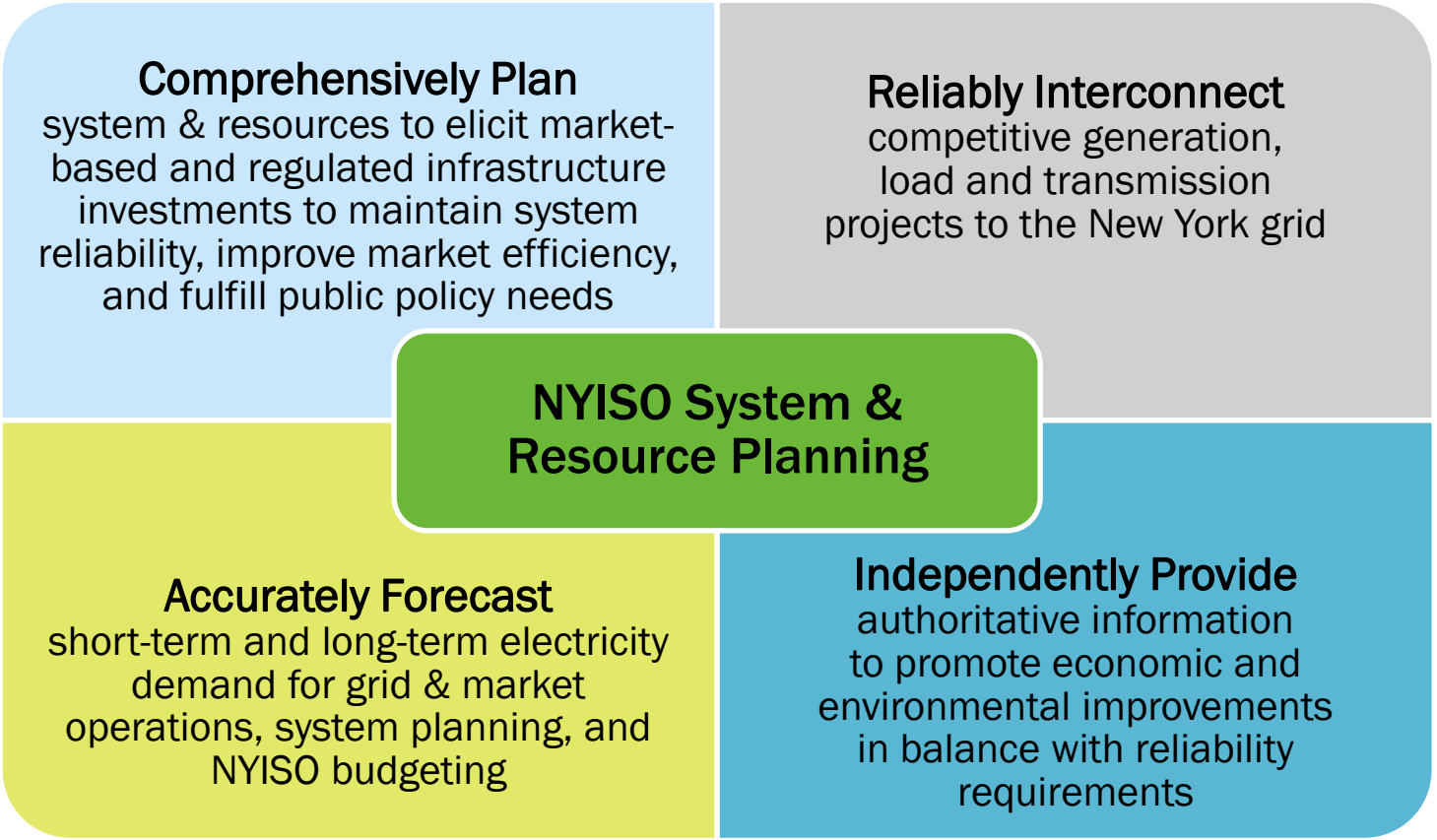

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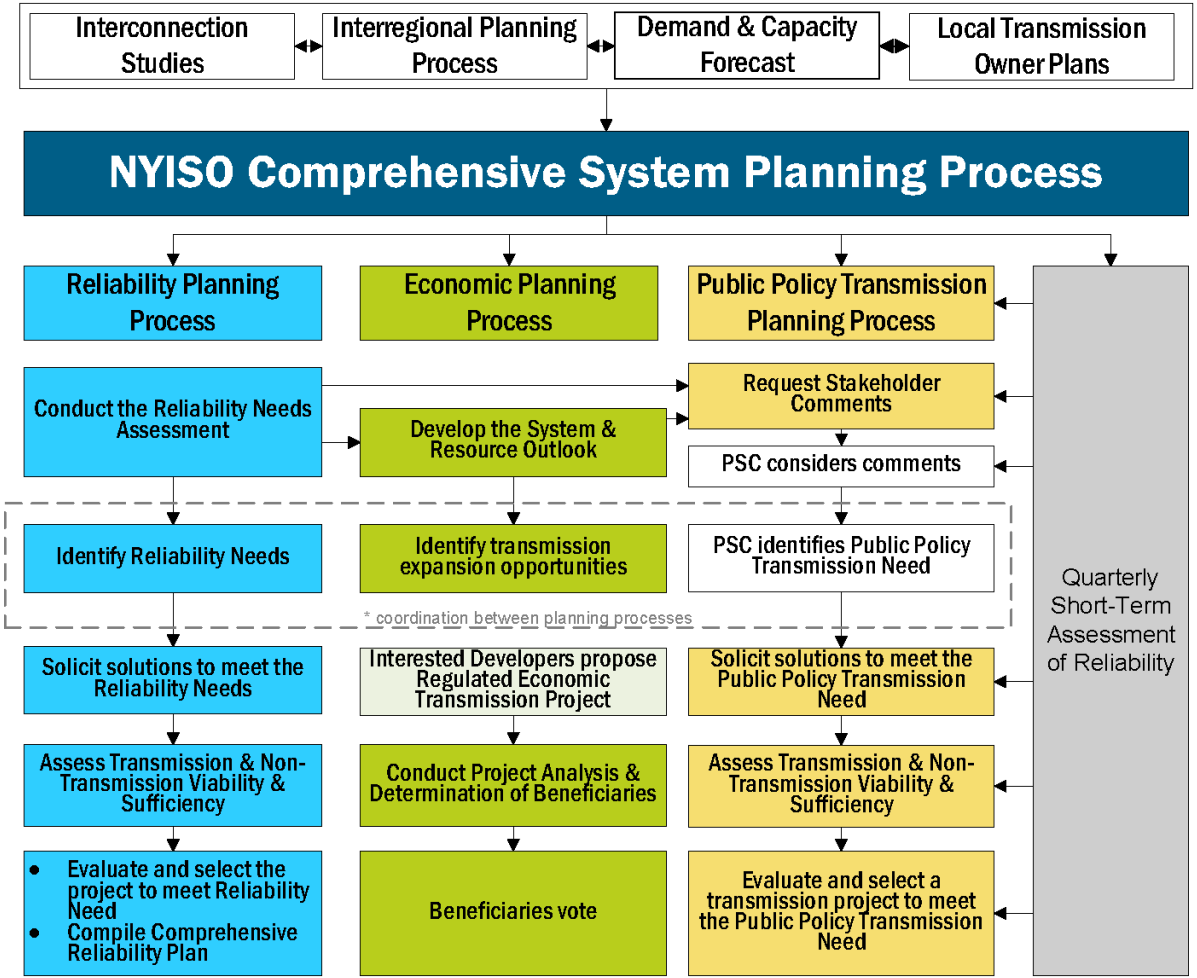

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System & Resource Outlook

System & Resource Outlook Scope

Model Development

- Reference cases
- Sensitives and Scenarios

Congestion Assessment

- Historic & Future Transmission Congestion
- Congestion Relief Analysis

Renewable Pocket Formation

Projected Operations & Market Impact Analysis

Energy Deliverability Assessment

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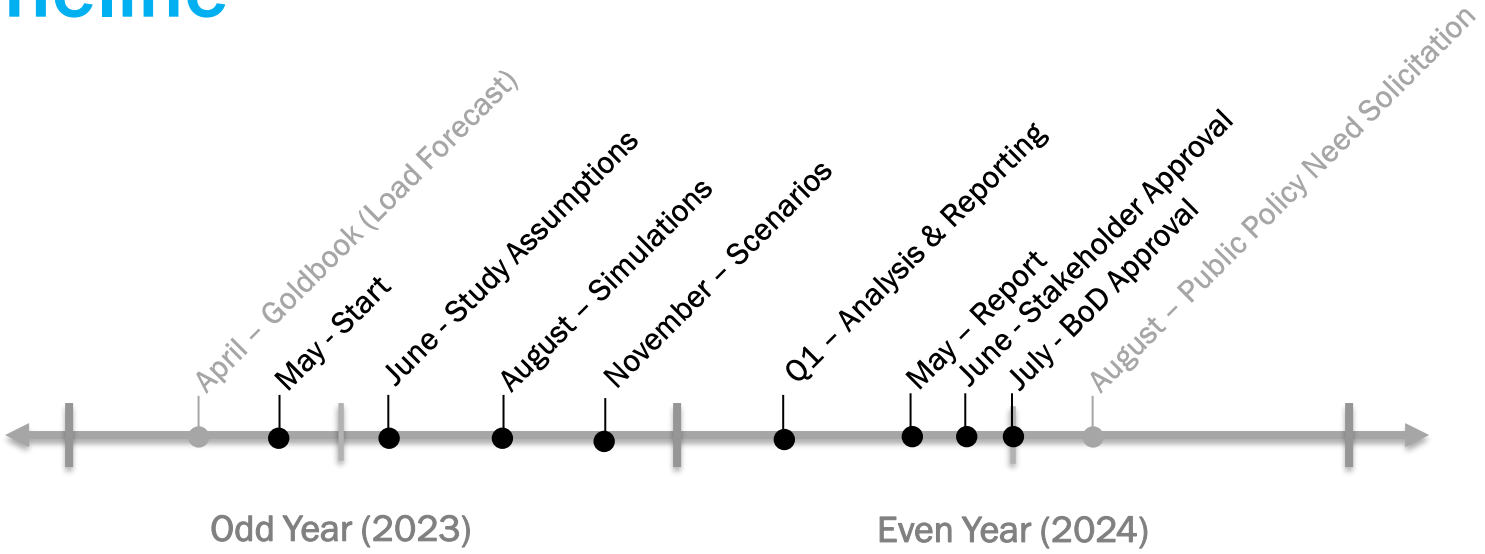
System & Resource Outlook

Timeline



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Power System Tools in The Outlook

- **Production Cost**
  - GE MAPS
- **Capacity Expansion**
  - PLEXOS
- **Powerflow and Transfer Analysis**
  - PowerGEM TARA
- **Reserve Analysis**
  - EPRI DynADOR

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Outlook Reference Case Models

- **Base Case**
  - Assumptions aligned with Reliability Planning Process
- **Contract Case**
  - Base Case + renewable projects with existing REC contracts
- **Policy Cases (2 Scenarios)**
  - Contract Case + New York CLCPA carbon-free targets and goals
  - This is the only case that leverages a capacity expansion model

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Policy Cases

- **Two distinct Scenarios modeled (S1 & S2)**
- **Major updates beyond Base & Contract cases include:**
  - CLCPA policies all modeled to achievement
  - Increased demand forecasts due to electrification
  - “Tier 4” HVDC projects modelled + NYPA AC Upgrade
  - Most recent IRM/LCR used to maintain reliability
  - Dispatchable Emissions Free Resources (DEFR) proxy technology, which operates like a fully flexible combined cycle with 24x7 availability and CO2 free production

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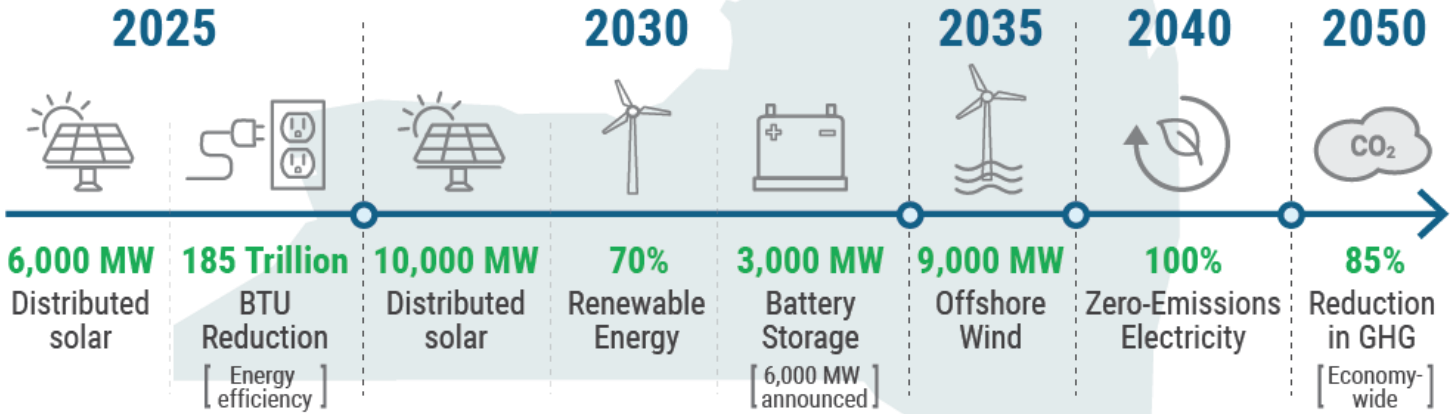
State energy policy goals



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Annual Energy & Peak Summaries for Load Forecasts

Scenario 1

Scenario 2

Base & Contract Cases

Annual Energy Forecasts - GWh

Year	Outlook CLCPA Case	Lower Load Case (2021 Gold Book)	Alternate Case (Draft Scoping Plan)
2025	144,704	146,170	150,047
2030	150,909	145,960	164,256
2035	172,566	151,250	204,702
2040	208,679	160,980	235,731

Summer Peak Forecasts - MW

Year	Outlook CLCPA Case	Lower Load Case (2021 Gold Book)	Alternate Case (Draft Scoping Plan)
2025	31,679	31,470	29,612
2030	34,416	31,453	30,070
2035	40,033	32,117	34,402
2040	48,253	32,812	38,332

Winter Peak Forecasts - MW

Year	Outlook CLCPA Case	Lower Load Case (2021 Gold Book)	Alternate Case (Draft Scoping Plan)
2025	26,491	24,065	21,758
2030	31,717	25,252	25,892
2035	41,681	28,347	35,093
2040	57,144	32,668	42,301

*Annual Energy Forecasts for the *Outlook CLCPA Case* and *Lower Load Case* are representative of net load forecast (i.e., inclusive of impacts from Behind-the-Meter solar)

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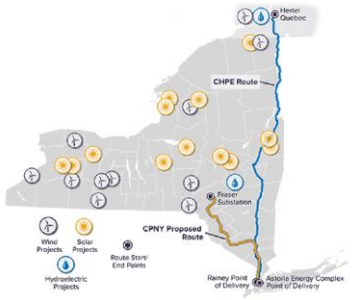
Tier 4 HVDC Projects



- **NYSERDA Tier 4 Solicitation resulted in two awarded projects:**
  - **Champlain Hudson Power Express:** HVDC transmission project from Québec, Canada to New York City was modeled as importing 1,250 MW for all hours of the year from Québec to the Astoria 345kV substation in New York City and is expected in-service in 2025.
  - **Clean Path New York:** HVDC transmission project from Fraser 345 kV substation in Delaware County, New York to Rainey 345 kV substation in New York City was modeled as controllable transmission capable of flowing 1,300 MW from upstate to downstate and is expected in-service in 2027.

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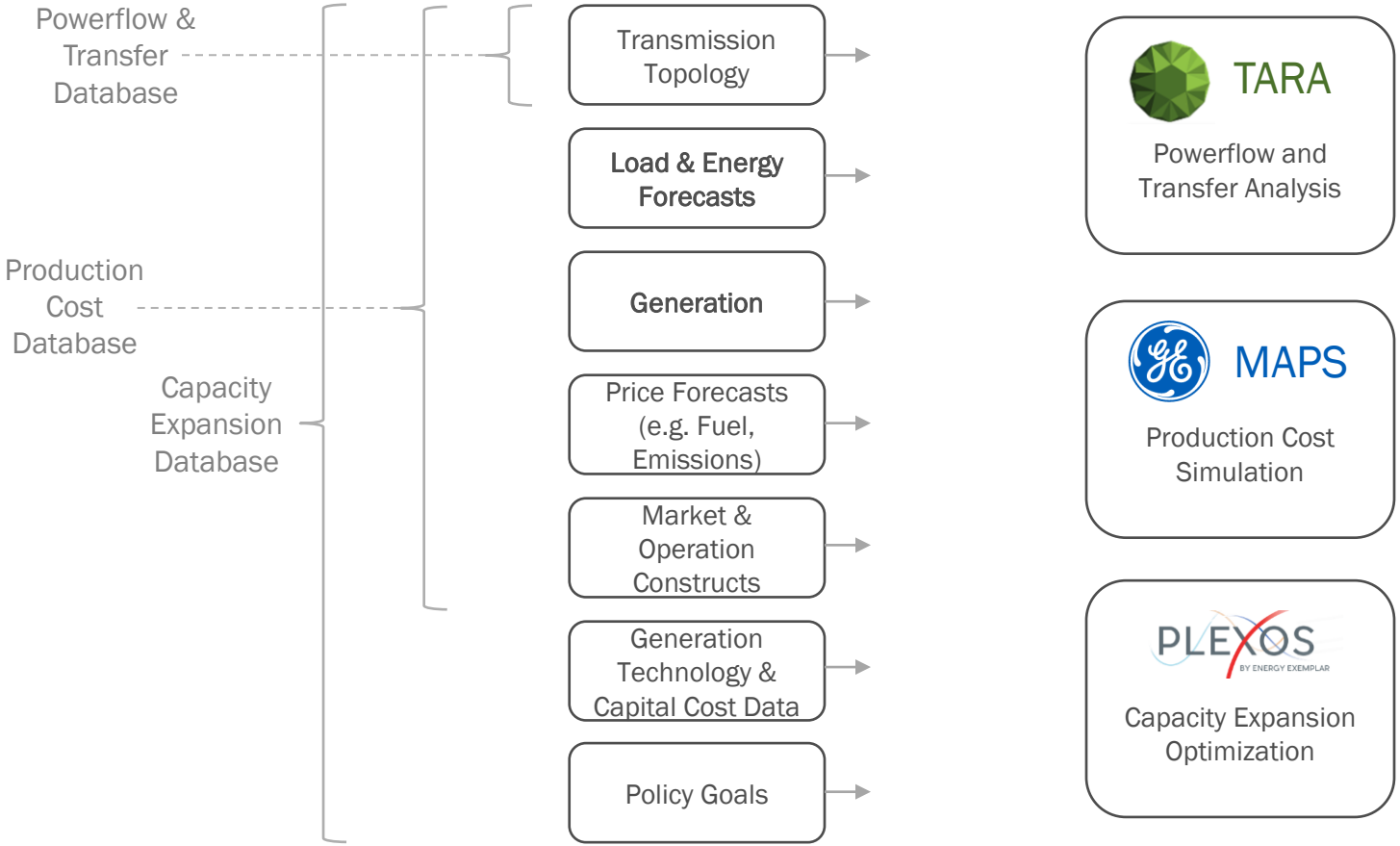
Data & Models in Policy Case



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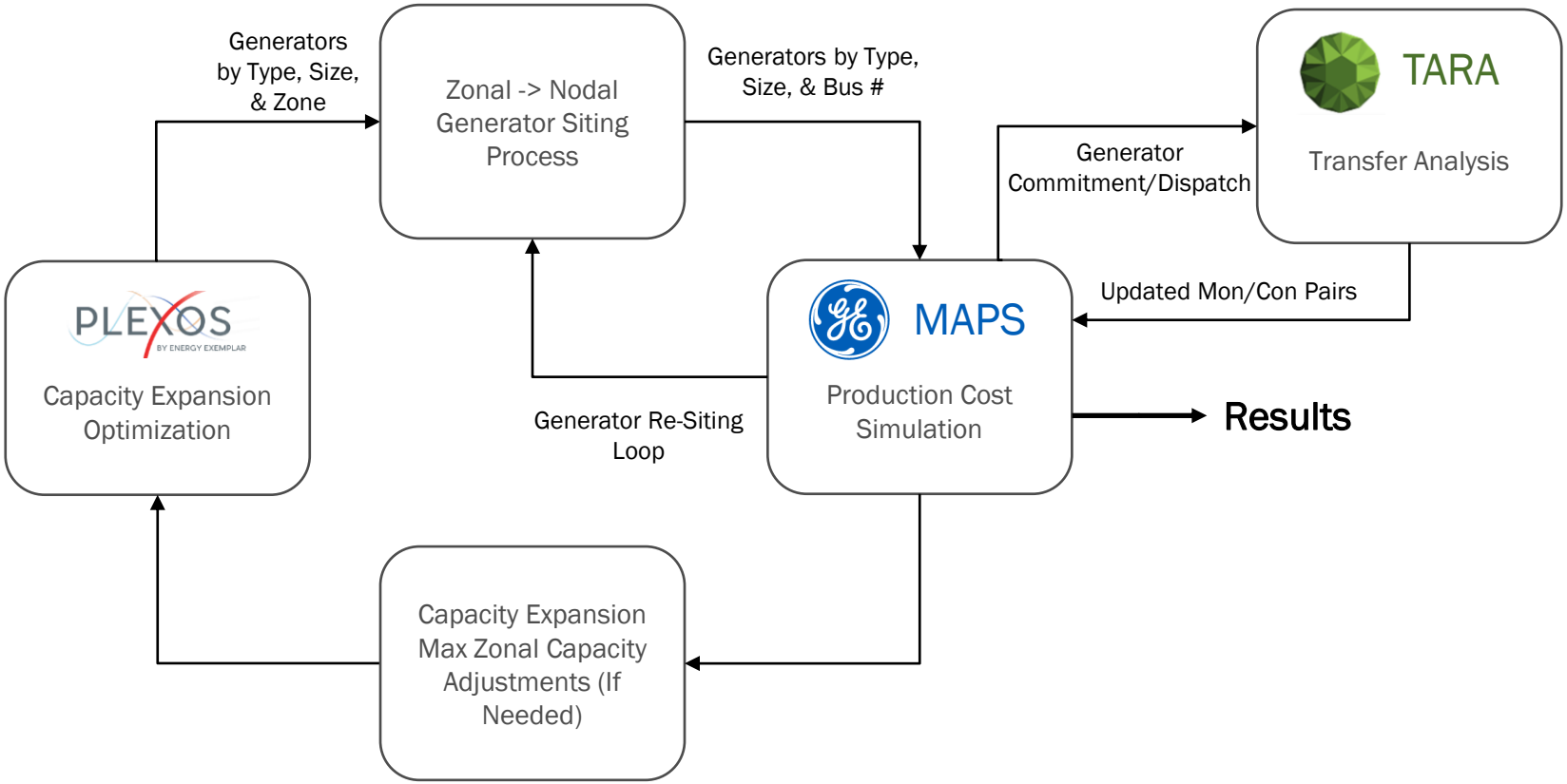
Policy Case Simulation Framework



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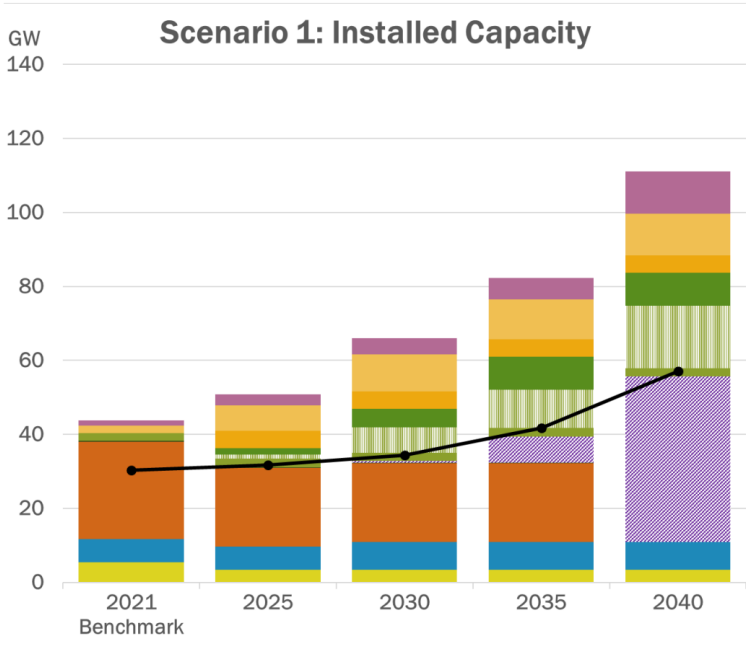
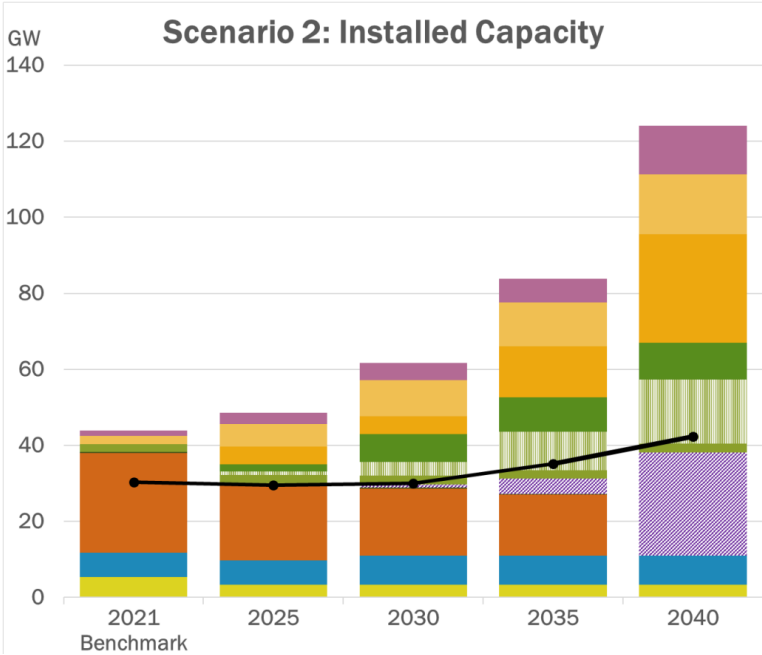
Capacity Expansion Model Results





ExistingNuclear NewNuclear Hydro ExistingFossil NewFossil Other DEFR
ExistingLBW NewLBW OSW UPV BTM-PV ESR Peak Load

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Dispatchable Emissions Free Resources (DEFRs)

The DEFR Concept

1. To meet "100x40" new emission-free technologies are likely to be needed
2. We do not necessarily know the cost and operational attributes of future technologies
3. Rather than choosing a specific future technology to meet objectives we can learn more about the attributes needed by these resources by introducing a proxy technology in both capacity expansion and production cost models
4. In capacity expansion, model 3 different cost profiles of capital & operating costs
5. In production cost, model DEFRs chosen by capacity expansion as fully flexible emissions-free generators
6. Observe DEFR selections & operation to identify needs

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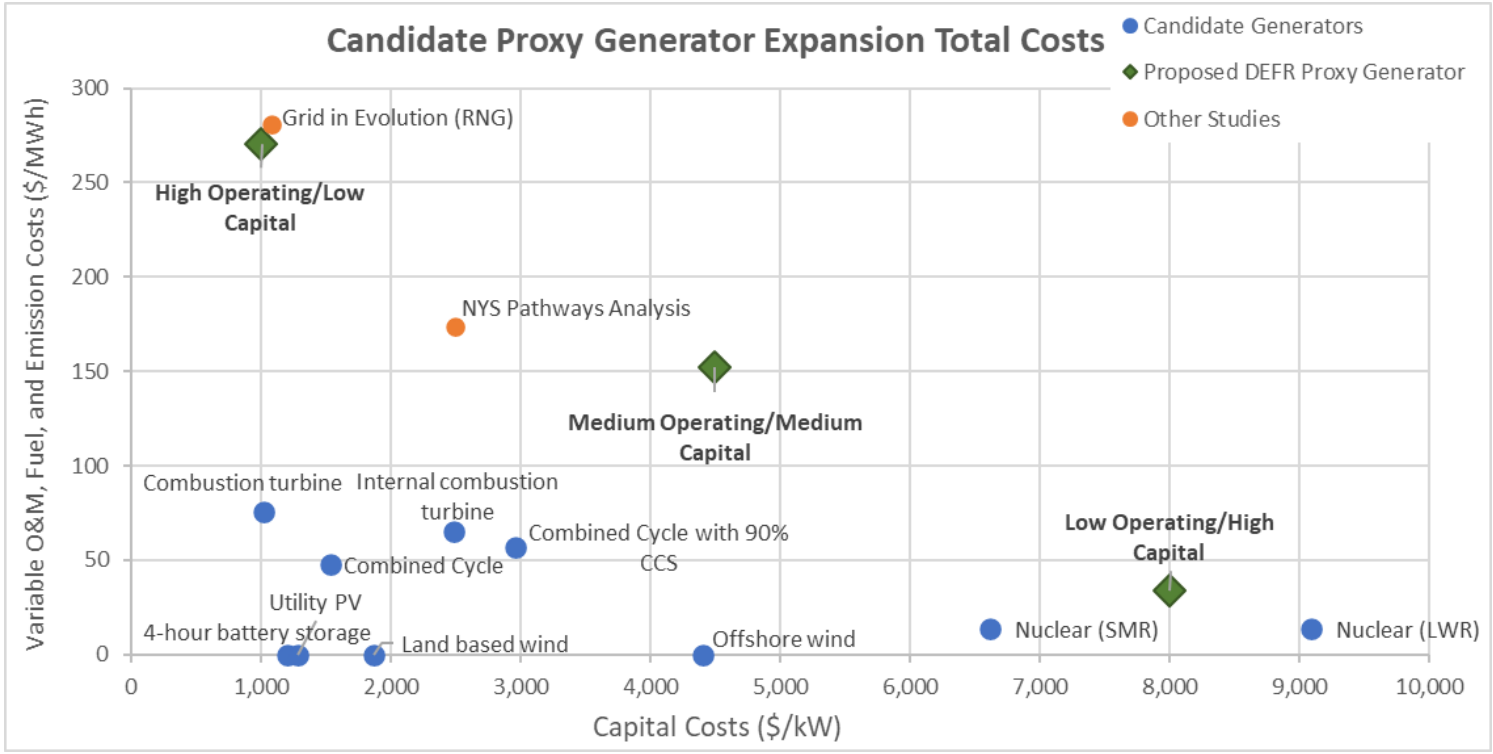
DEFR Cost Profiles



https://www.eia.gov/outlooks/aeo/assumptions/pdf/table_8.2.pdf

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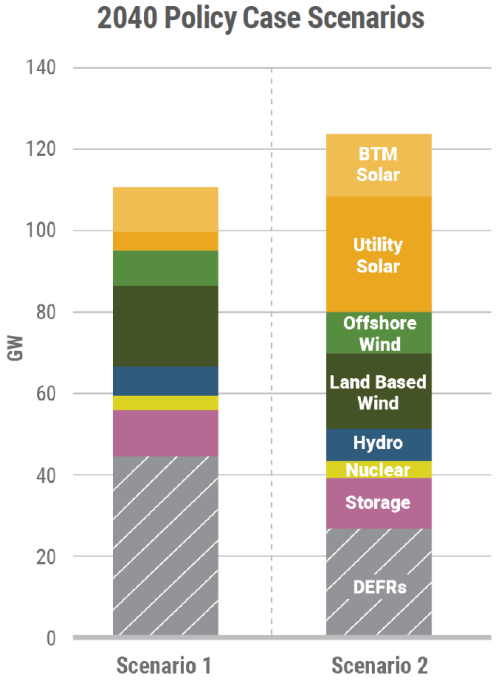
What Did We Learn?

- Load & reserve margin primary drivers
- ~20-40% DEFR capacity by 2040
- Higher peaks -> more LcHo DEFRs
- LcHo DEFR preferred (some DEFRs were only build to meet RM)
- Highest capacity factors and ramping events in summer/winter
- Cycling in spring/fall



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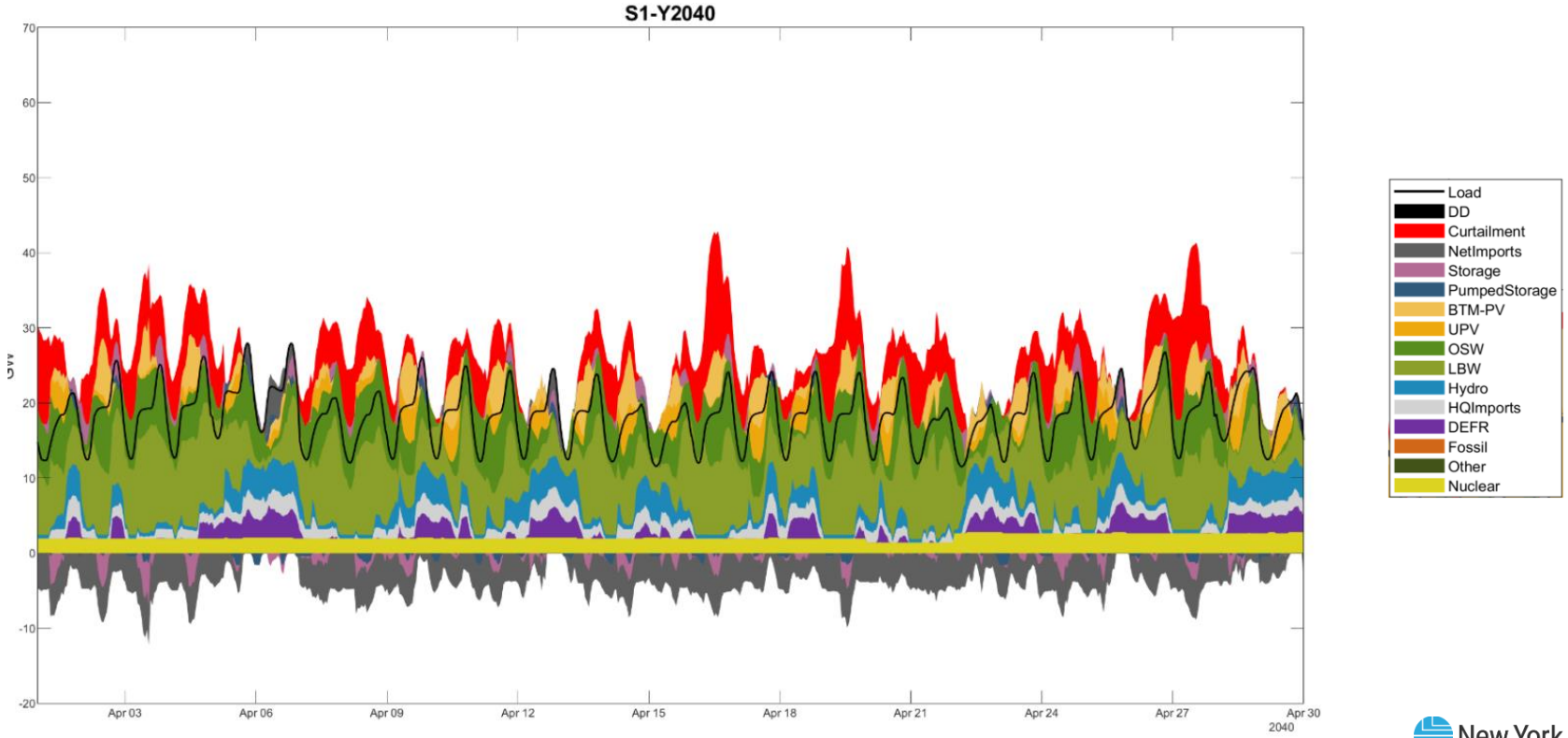
Example 2040 Spring Dispatch



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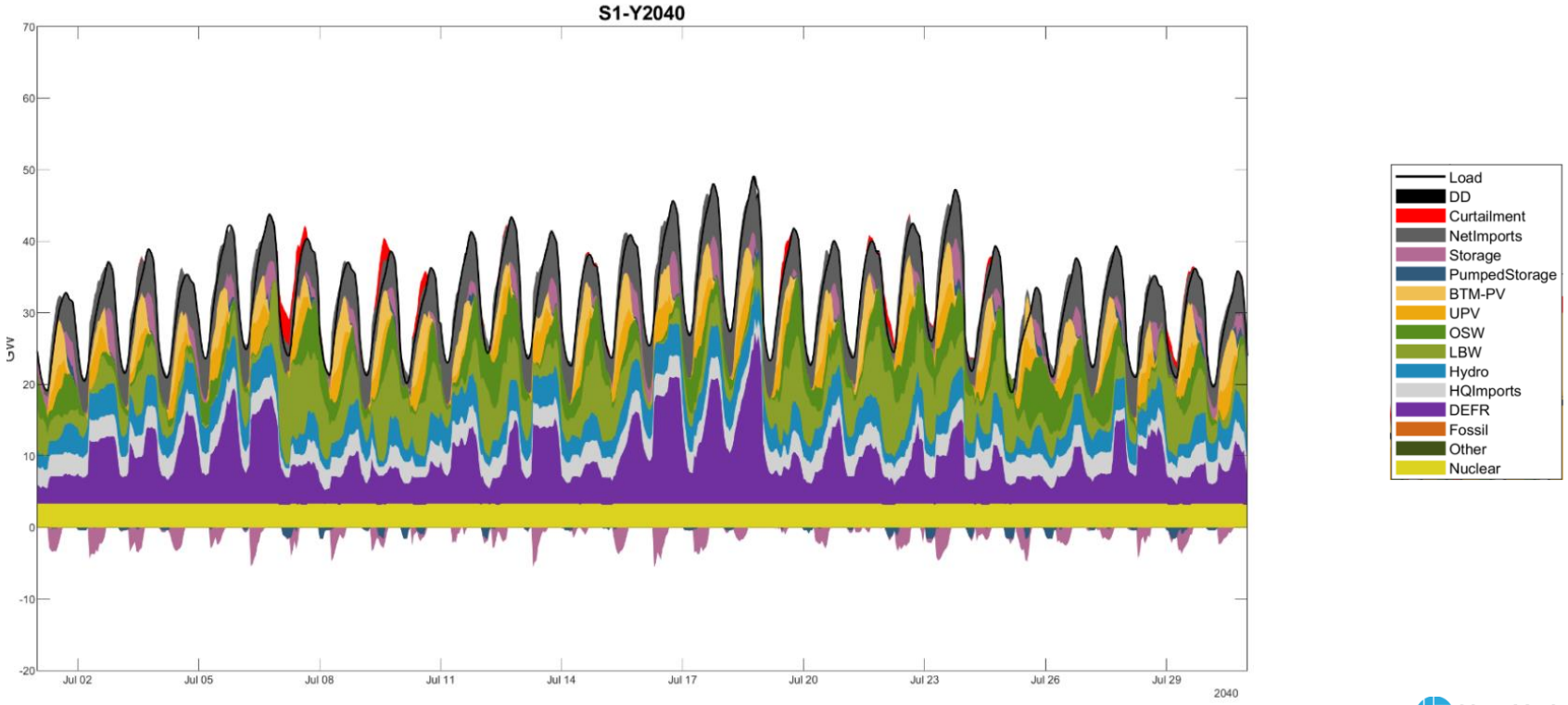
Example 2040 Summer Dispatch



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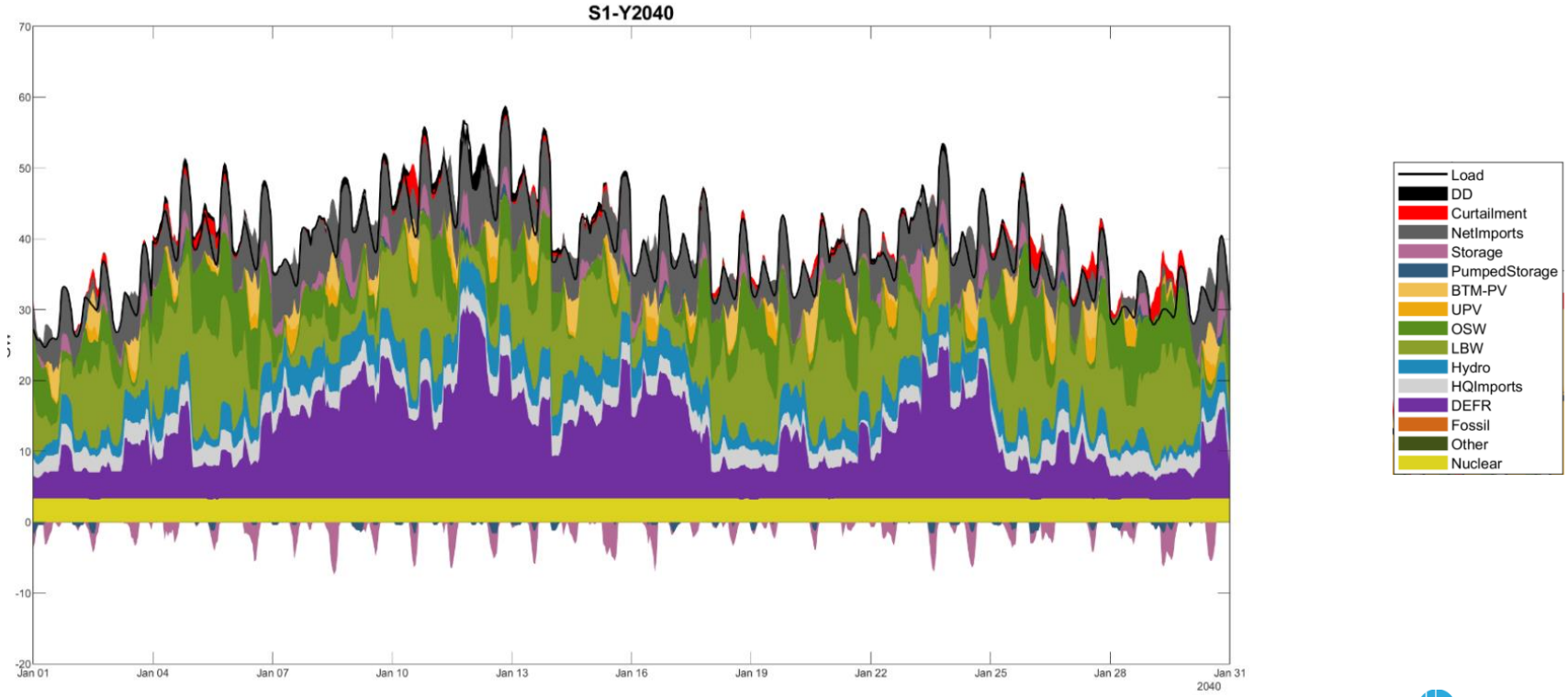
Example 2040 Winter Dispatch



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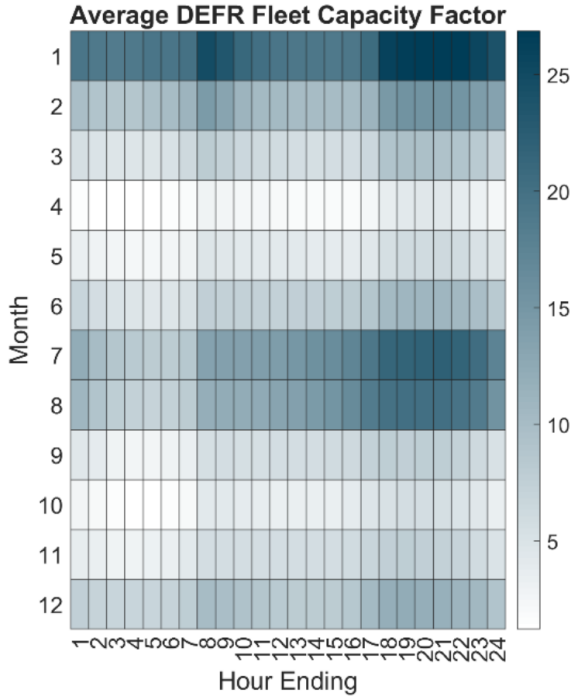
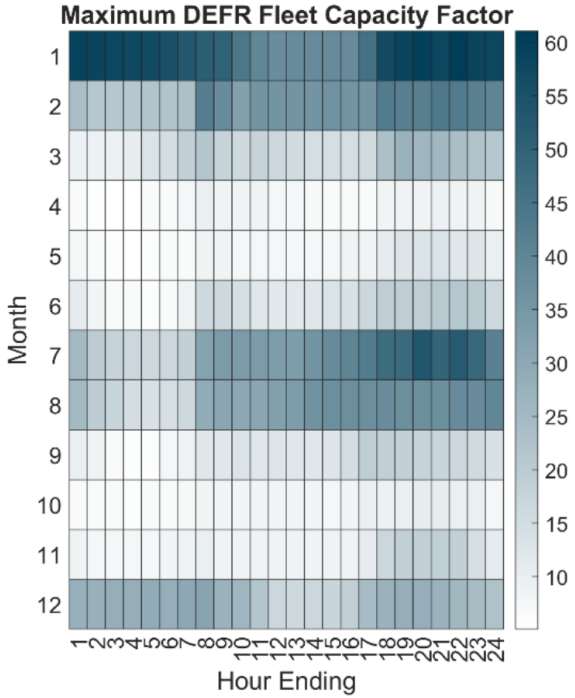
DEFR Avg & Max Capacity Factors





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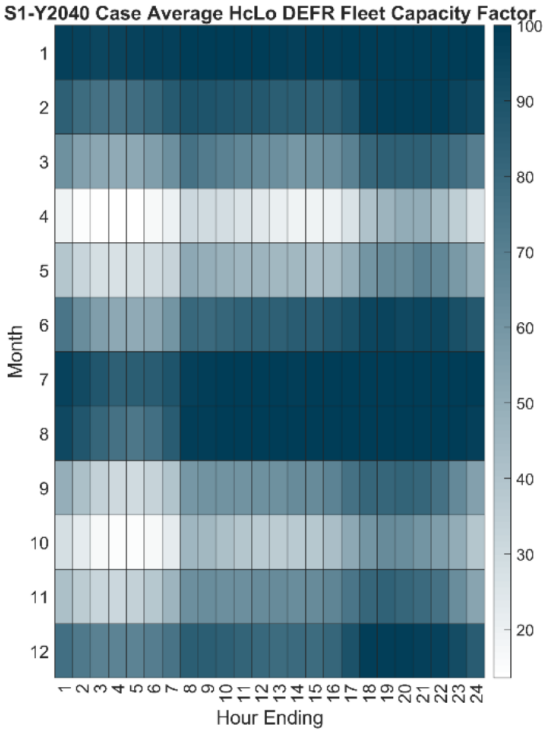
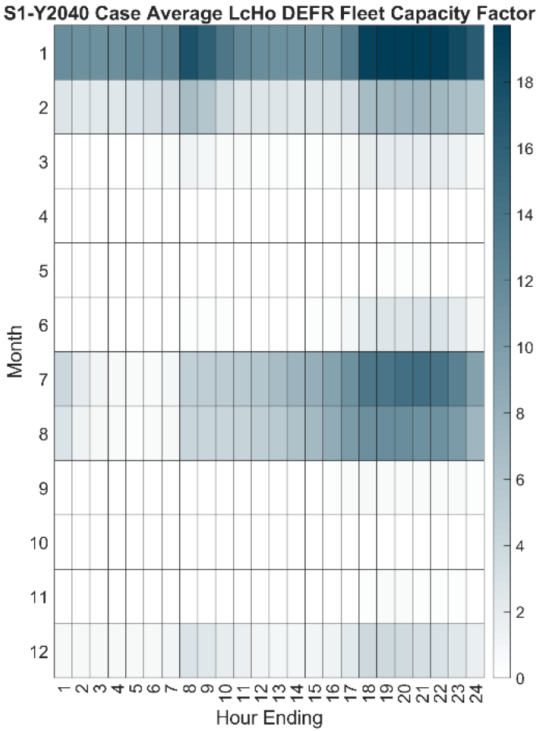
DEFR HcLo vs LcHo CF%





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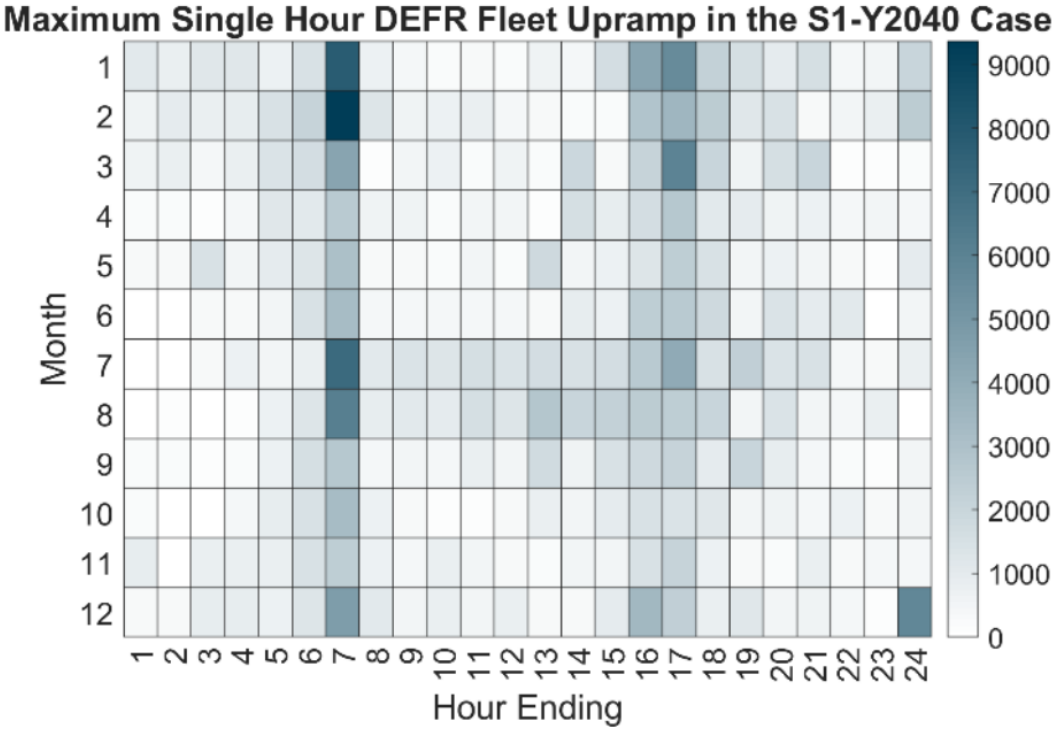
DEFR Max Up-Ramp (MW/hr)



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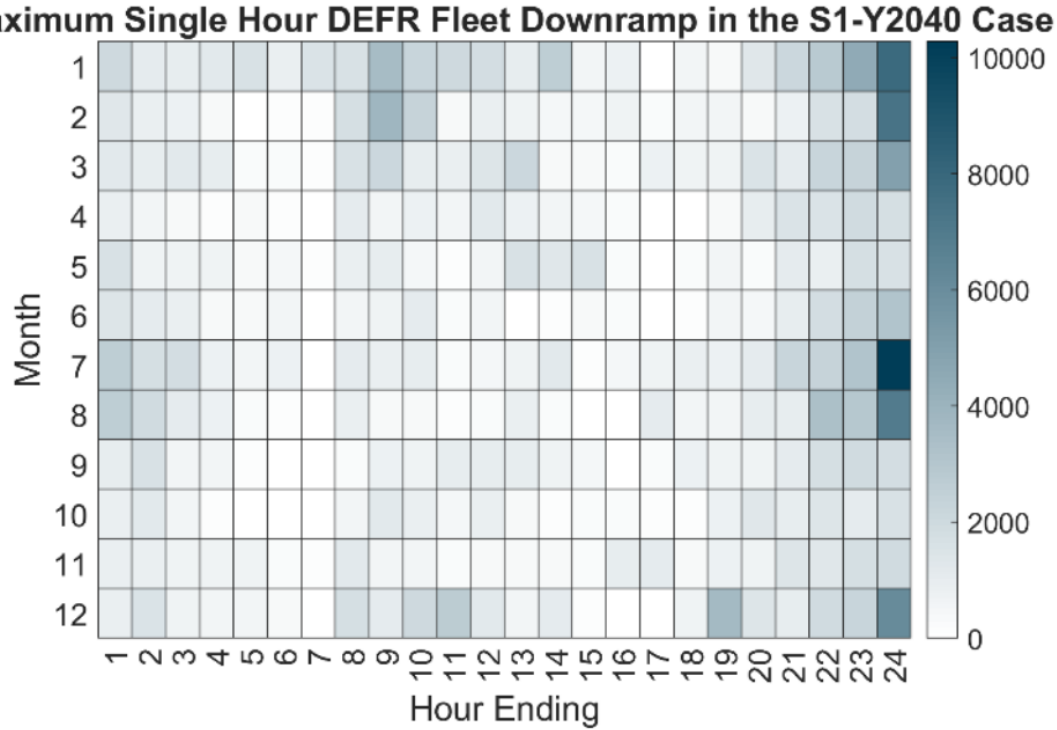
DEFR Max Down-Ramp (MW/hr)



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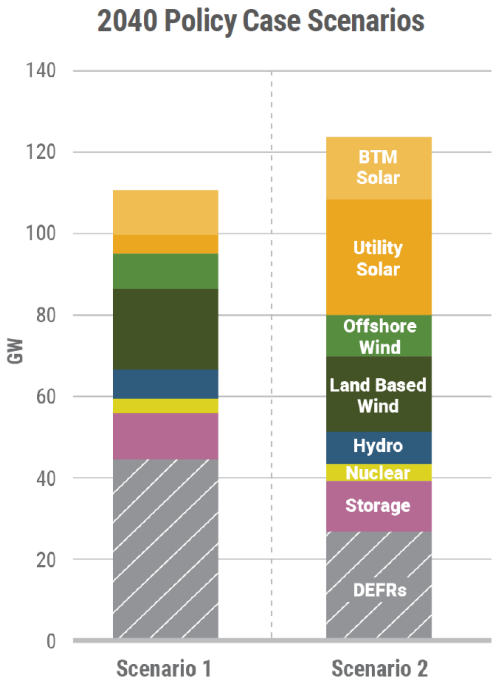
Conclusions & Questions

What DEFR Technologies Will Be Developed?



✓ **To achieve an emission-free grid, dispatchable emission-free resources (DEFRs) must be developed and deployed throughout New York.** DEFRs that provide sustained on-demand power and system stability will be essential to meeting policy objectives while maintaining a reliable electric grid. While essential to the grid of the future, such DEFR technologies are not commercially viable today. DEFRs will require committed public and private investment in research and development efforts to identify the most efficient and cost-effective technologies with a view towards the development and eventual adoption of commercially viable resources. The development and construction lead times necessary for these technologies may extend beyond policy target dates.

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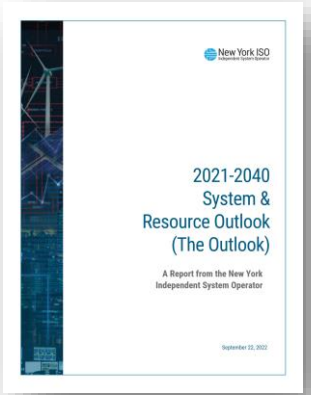
2021-2040 System & Resource Outlook Data Catalog

Report



Study Summary

Appendices

- Appendix A: Glossary
- Appendix B: Economic Planning Studies
- Appendix C: Production Cost Assumptions
- Appendix D: Capacity Expansion Assumptions
- Appendix E: Modelling & Methodologies
- Appendix F: Results Summary & Charts
- Appendix G: Capacity Expansion Scenarios
- Appendix H: Base & Contract Case Results
- Appendix I: Transmission Congestion Analysis
- Appendix J: Renewable Generation Pockets

Data Documents

- Capacity Expansion Assumptions Matrix
- Production Cost Assumptions Matrix
- Fuel Price Forecast
- Emissions Price Forecast
- Contract Case Renewable Projects
- Hourly Load Forecasts
- Detailed Model Output Data File
- MMU Renewable Profiles
- MMU Hourly LBMPs
- Outlook Policy Case Additions
- Policy Case LBMP Summary

Stakeholder Presentations

May 20, 2021
- Model Benchmark Results

September 22, 2021
- System & Resource Outlook Update

October 25, 2021
- Capacity Expansion Model Primer
- System & Resource Outlook Update

November 19, 2021
- System & Resource Outlook Update

December 19, 2021
- System & Resource Outlook Update

January 25, 2022
- System & Resource Outlook Update

February 9, 2022
- System & Resource Outlook Update
- Base & Contract Case Results

February 25, 2022
- System & Resource Outlook Update

March 8, 2022
- System & Resource Outlook Update

March 24, 2022
- System & Resource Outlook Update
- Contract Case Congestion Analysis

April 1, 2022
- System & Resource Outlook Update

April 26, 2022
- System & Resource Outlook Update

May 23, 2022
- System & Resource Outlook Update

June 2, 2022
- System & Resource Outlook Update

June 8, 2022
- System & Resource Outlook Update
- Updated 6/2 Presentation

June 21, 2022
- System & Resource Outlook Update

August 8, 2022
- System & Resource Outlook Update

August 17, 2022 (BIC)
- System & Resource Outlook Update

August 31, 2022 (MC)
- System & Resource Outlook Update

October 25, 2022 (Public Information Session)
- System & Resource Outlook

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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

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