2019 CARIS 1 70x30 Scenario Development

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Agenda

- Background
- 70x30 Scenario Development and Assumptions
- Discussion and Suggestions

Renewable and Clean Energy Mandates

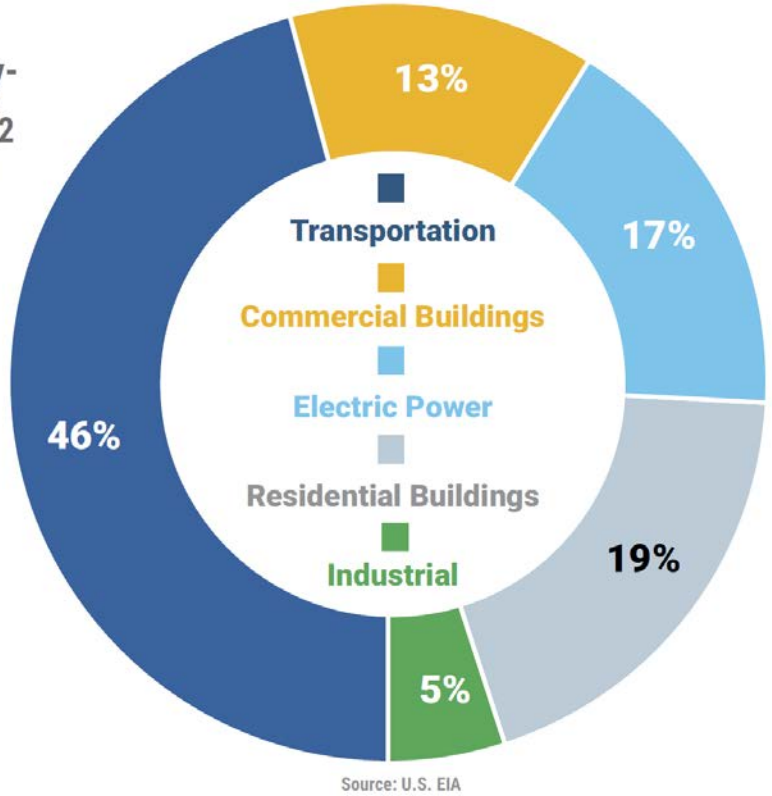
- **2025 – 6,000 MW Behind-the-meter PV (BTM-PV):**
  - NY-Sun 3,000 MW BTM-PV by 2023
- **2025 – 185 TBtu site-energy savings Energy Efficiency (EE) Target**
  - 600 TBtu primary-energy savings by 2030
- **2029 – Zero Emission Credits (ZECs) eligible to upstate nuclear through March**
- **2030 – 70% Renewable Energy (RE)**
- **2030 – 3,000 MW Energy Storage Resources (ESR)**
  - Energy Storage 1,500 MW by 2025
- **2035 – 9,000 MW Offshore Wind (OSW)**
  - 2,400 MW by 2030
  - 2018 OSW Solicitation resulted in 1,696 MW procurement

https://www.nysenate.gov/legislation/bills/2019/s6599

Emission Reductions Not Considered

- 2030 – 40% economy-wide GHG reduction
- 2040 – "zero emission" power sector
- 2050 – 85% economy-wide GHG reduction (and up to 15% additional as offsets)
  - "Sources in the electric generation sector shall not be eligible" to offset emissions

Figure 23: NYS Energy-Related CO_2 Emissions by Sector



2019 Power Trends (2016 data), https://www.nysenate.gov/legislation/bills/2019/s6599

NYS DEC Air Regulations

- DEC proposed “Peaker Rule” Part 227-3 could impact ~3,300 MW peaking generation in Zone J and Zone K
- DEC final Part 251 precludes coal-firing in 2021

Getting to 70x30: From the CARIS Base Case

- 70x30 Scenario will be developed from the 2019 CARIS 1 base case 2028 model year
- Following slides summarize current thoughts on various potential changes to the base case
- The NYISO seeks comments on the assumptions outlined

Getting to 70x30: Base Case Adjustment

- Load Forecast/Shape
- Neighboring system assumptions
- Modeling Energy Storage Resources (ESR)
- NYCA Nuclear and Fossil Fleet Operations
- RE Amounts, Locations and Modeling

Load Forecast/Shape

- High Load scenario as initial input assumption for 70x30 scenario load to reflect limited degree of electrification as an emissions reduction strategy that is yet to be defined
- Modify load to accommodate 185 TBtu site-energy savings target
  - Adjust forecast for “sub-target Electric Site Savings” of 30,000 GWh by 2025
  - Assume CES EE savings of 2,227 GWh/yr incremental for 2026-2030

Neighboring system assumptions

- **Policy expectations in other states/provinces directionally align with NY seeking lower emissions and increasing RE generation**
  - RE resource fleets in neighboring pools modeled as in base case
  - Ontario nuclear operations modeled as in base case
- **Imports of Canadian Hydro/HVDC additions counted towards 70x30**
  - Generic HVDC 1,250 MW with HQ schedule to Zone J
- **Assume average RE% content and emission rate of system mix associated with energy transfers between pools**

Modeling of Energy Storage Resources in MAPS

- **Capacity additions driven by state mandate of 3,000 MW**
- **Potential options for modeling ESR in MAPS**
  - MAPS's "pumped storage" model: ESR scheduled to minimize production cost against thermal generation commitment cost curve and corresponding load curve while satisfying ESR constraints
    - Each ESR must be placed at an individual bus
    - Assigned to given load, daily/weekly cycle, initial state of charge
    - Assumed capacity (energy and power) and efficiency
  - Hourly Resource Modifier: integrate ESR dispatch profile to bus level as is done for BTM-PV
    - Utilize approach to minimize net load deviations on a daily basis satisfying ESR power, energy, and round-trip efficiency constraints to compute ESR dispatch

Modeling ESR Methodologies Pros and Cons

	MAPS's "pumped storage" model	Hourly Resource Modifier
PRO	• endogenous dispatch calculation solves ESR constraints • simplifies workflow for running cases	• distribute to all busses as BTM-PV and/or selected bus as a project • multiple ESR objectives possible • more flexible and controllable • requires zonal capacity distribution
CON	• sole objective to minimize system production cost • dispatches ESRs in order listed in input file • requires more resource level assumptions	• requires off-line data processing and I/O method • exogenous in-house optimization algorithm developed and maintained

- Implement Hourly Resource Modifier as described on prior slide

NYCA Nuclear and Fossil Fleet Operations

- Upstate nuclear units eligible for ZECs under the CES through March 2029
- Extend upstate nuclear operations

Nuclear Unit	Zone	NP (MW)	DMNC_SUM (MW)	2015 - 2018 Average Gold Book Net Energy (GWh)	2015 - 2018 Maximum Gold Book Net Energy (GWh)	Online Date	Announced Retirement / NRC Operating License Expiration Date
Indian Point 2	H	1,299	1,016	7,804	8,812	8/1/1973	4/30/2020
Indian Point 3	H	1,012	1,038	7,993	9,076	4/1/1976	4/30/2021
Nine Mile Point 1	C	642	632	5,168	5,377	11/1/1969	8/22/2029
R E Ginna 1	B	614	581	4,808	5,063	7/1/1970	9/18/2029
James A Fitzpatrick 1	C	882	845	6,510	7,382	7/1/1975	10/17/2034
Nine Mile Point 2	C	1,399	1,288	10,576	11,054	8/1/1988	10/31/2046

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Gold Books, https://www.nrc.gov/reactors/power.html

Fossil Fleet Operations

- **Assume all coal plants retired by 2021**
  - Somerset in the base case, removed in 70x30 scenario
- **Assume "peaker" rule replacements corresponding to local Compensatory MW additions identified in 2019-2028 CRP**
  - 660 MW in Zone J and 620 MW in Zone K
  - Assume GT replacement to secure for long durations of deficiencies identified

RE Amounts

- **Assume 6,000 MW of OSW in 2030**
  - 50/50 split between Zone J and Zone K
- **First determine net effect of the mandated resources in the CL&CPA and then calculate annual energy required from Utility PV (UPV) and Land Base Wind (LBW) to achieve 70x30**
  - Assume RE content of imported electricity
  - Assumed energy split 50/50 between UPV and LBW

RE Locations

- Capacity additions of UPV and LBW calculated at annual NYCA level to achieve 70% RE requirement must then be ultimately distributed to the bus level to be modeled
- Developed capacity distribution schedule based on UPV and LBW capacity shares by zone from the 2017 and 2018 CES REC solicitation awards and the interconnection queue
- Capacity schedule shown will as a first step assign UPV and LBW capacity values to each zone
- Further refinement to place at individual buses in assigned zone

Nameplate Capacity Distribution		
	UPV	LBW
A	27%	40%
B	3%	0%
C	20%	28%
D	0%	7%
E	10%	25%
F	25%	0%
G	15%	0%
H	0%	0%
I	0%	0%
J	0%	0%
K	0%	0%
NYCA	**100%**	**100%**

RE Modeling

- **Incremental RE resources will be modeled as follows**
  - BTM-PV: scaling base case BTM-PV to desired output level
  - UPV: NREL Solar Power Data for Integration Studies
  - OSW: NREL Wind Toolkit
  - LBW: modeled consistent with new LBW additions in the base case
- **Additional information on NREL wind and solar data included in appendix to this presentation**

Feedback/Comments?

- Email additional feedback to: BCohen@nyiso.com

The Mission of the New York Independent System Operator, in collaboration with its stakeholders, is to serve the public interest and provide benefits to consumers by:

- Maintaining and enhancing regional reliability
- Operating open, fair and competitive wholesale electricity markets
- Planning the power system for the future
- Providing factual information to policy makers, stakeholders and investors in the power system

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Appendix – NREL Data

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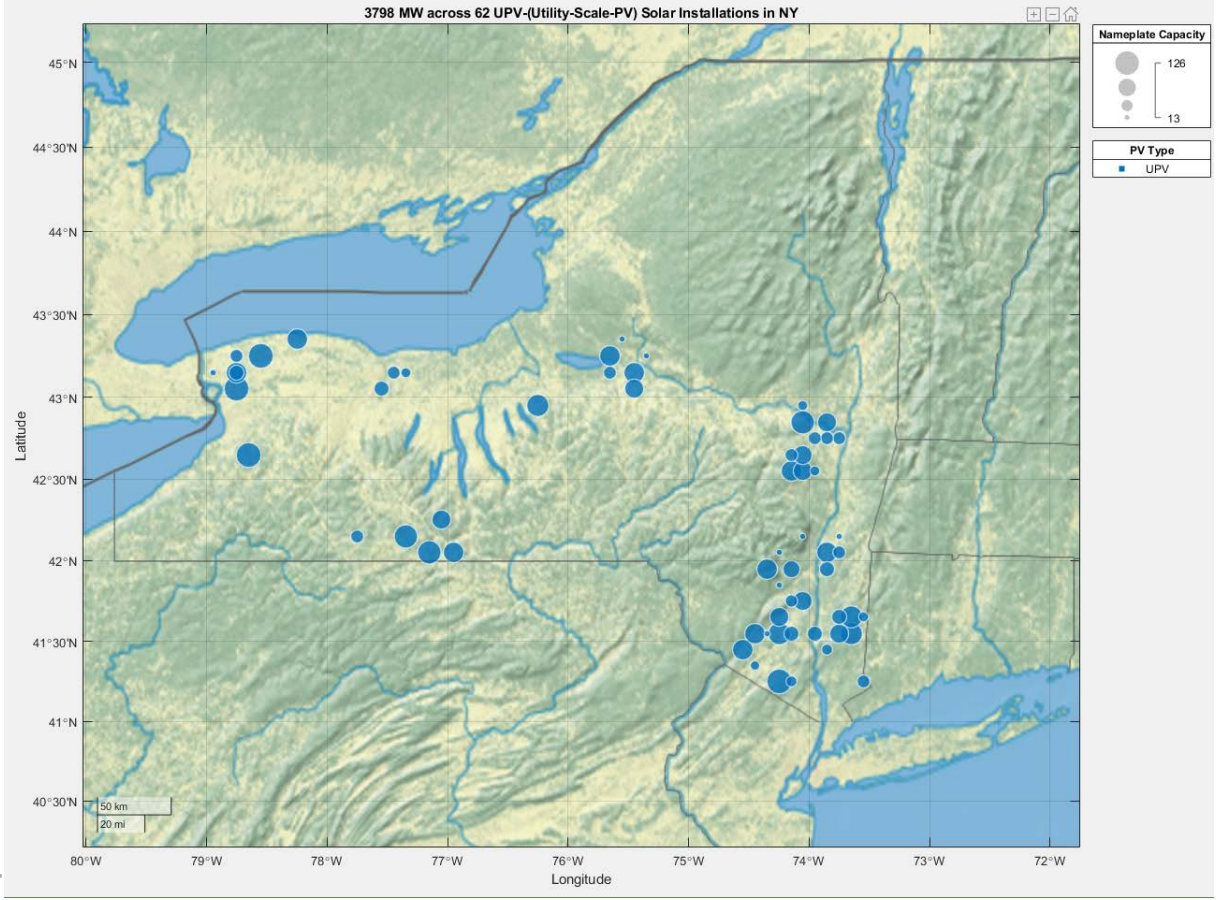
NREL Wind and Solar Data

- **Wind and Solar profiles obtained from NREL's *Wind Toolkit* and *Solar Power Data for Integration Studies***
  - Databases were developed specifically to model wind and solar resources in renewable integration studies
  - Data is freely available to the public
- ***Wind Toolkit*** **-** https://www.nrel.gov/grid/wind-toolkit.html
  - 5-minute profiles for sites in the US (to be aggregated to hourly level)
  - Land Based Wind (LBW) and Offshore Wind (OSW) available
- ***Solar Power Data for Integration Studies*** **-** https://www.nrel.gov/grid/solar-power-data.html
  - 5-minute 'actual' profiles (to be aggregated to hourly level)
  - Distributed (DPV) and Utility PV shapes at site level available
  - Each site defined by unique capacity, location, DPV/UPV and output profile
  - Corresponding hourly Day Ahead and 4-hr ahead forecasts available

New York Utility PV in NREL Database

- NREL database contains UPV shapes representing 62 sites in NY totaling 3,798 MW



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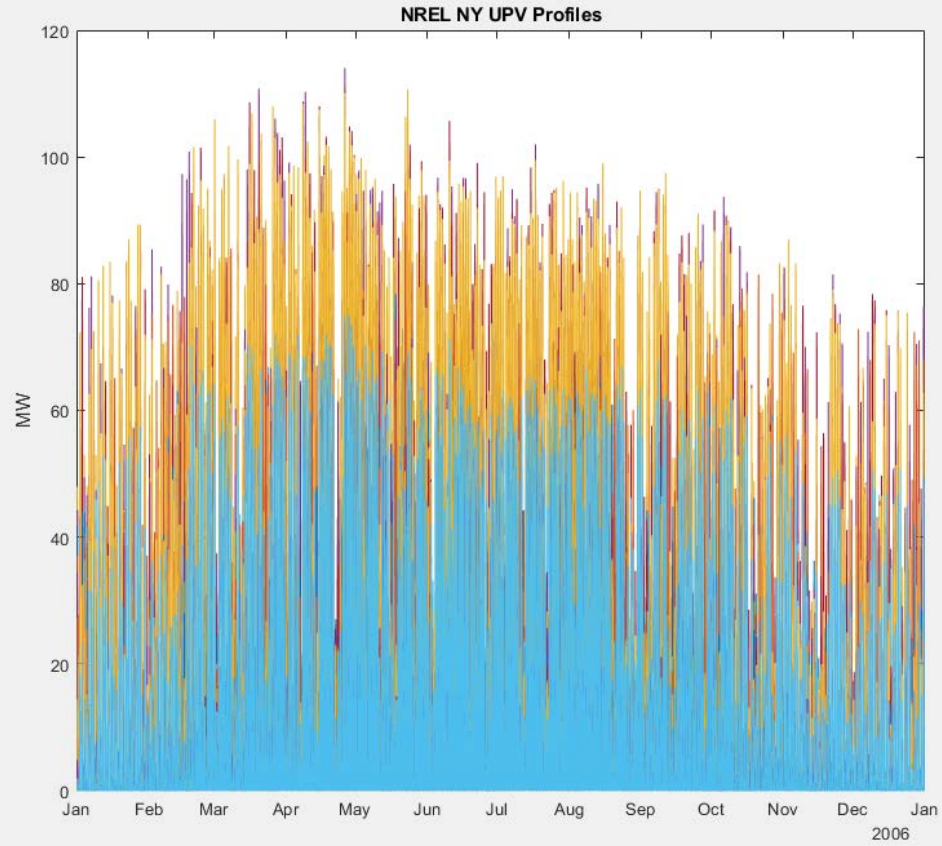
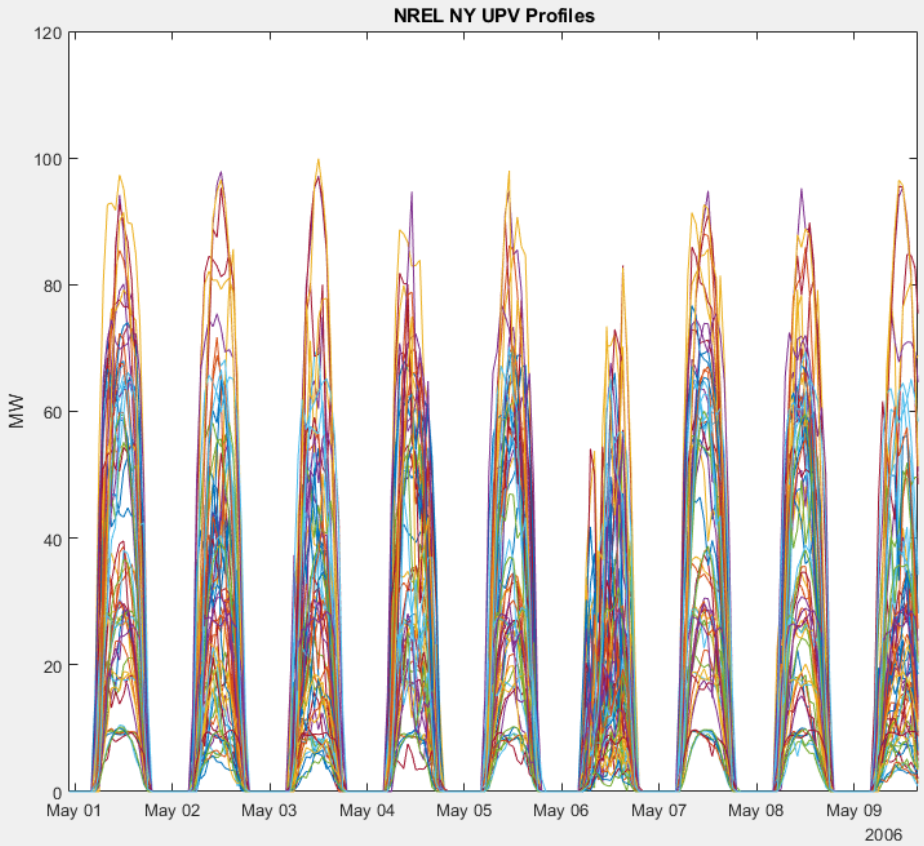
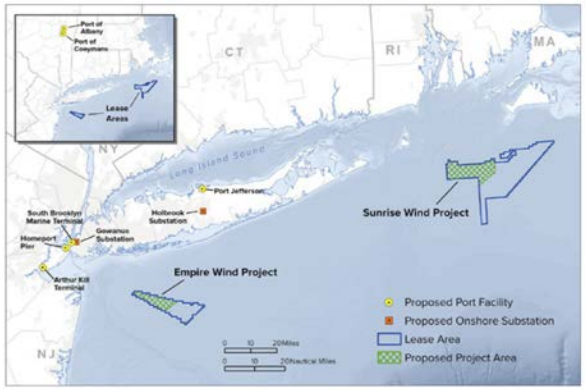
NREL NY Utility PV Profiles





NREL OSW Database

- Selected sites in the NREL database approximating location of announced OSW projects
  - South Forks (130 MW over 14 sites)
  - Empire (816 MW over 15 sites)
  - Sunrise (880 MW over 18 sites)
- Aggregated hourly profiles to OSW project level - scaled to project capacity
- Additional OSW capacity added up to assumed 6,000 MW



Wind Toolkit OSW Sites

https://www.nyserda.ny.gov/All-Programs/Programs/Offshore-Wind/Offshore-Wind-Solicitations/Generators-and-Developers/2018-Solicitation , https://maps.nrel.gov/wind-prospector/