New York ISO
Independent System Operator

System & Resource Outlook Update

Economic Planning Department

Electric System Planning Working Group (ESPWG)

Tuesday March 8, 2022 – WebEx Teleconference

Agenda

- Outlook Study Status
- Capacity Expansion Scenario Update
- Capacity Expansion Model Overview
- Preliminary Capacity Expansion Model Results
- Next Steps

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Outlook Study Status

- September – October 2021: Finalize reference case assumptions*
- November - December 2021: Conduct simulations and analysis*
- January, February, March, April 2022 : Conduct Policy case simulations and analysis, issue draft report*
- April-May 2022: Finalize draft report, seek Business Issues Committee and Management Committee review and approval
- June 2022: Seek Board of Directors review and approval

* Collaborate with ESPWG and seek stakeholder input

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Requests from last ESPWG

- Descriptions of scenario modeling
- Preliminary capacity expansion model results

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Capacity Expansion Scenario Update

Assumptions Matrix

- Updated documents posted here

Potential Capacity Expansion Scenarios

Legend
Infeasible
Under Consideration
In-Progress
Preliminary Results

NYISO Suggested Scenarios

- Candidate technologies available
- Nuclear re-licensing/retirement
- High/low renewable technology cost
- High/low/alternative load forecasts
- Low/ high gas prices
- Low/ high emission prices
- Enable/disable/accelerate retirements
- Include/exclude max capacity builds
- Relax/accelerate CLCPA targets
- Reduced hydroelectric energy output
- Fixed capacity value curves

Stakeholder Suggested Scenarios

- Zone J remove all SCR Emergency Response Capacity
- Zone J retire any generator over 40 years old
- Transmission expansion
- NYSERDA Integration Analysis: Scenario 2 load forecast
- $0 REC bidding
- Distribution of OSW capacity between Zones J and K
- NYC steam heat converted to electric
- Accelerated winter peaking load profile
- Tier 4 project removal
- Reliability margin
- IRM/LCR study transmission limits

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Proposed Scenario Model Adjustments

Scenario	Assumption Adjusted	Value
High/Higher CO_2	CO_2 price forecast	2x / 10x
Load Profile	Load forecast	Draft Climate Action Council Scoping Plan Analysis Forecast
Low renewable technology cost	Build cost for applicable technologies	Climate Action Council projections
Candidate technologies available	Max units for applicable technologies	0
Age based fossil generation retirements	Retirement date	Climate Action Council Appendix D
Reliability Margin	URM	Increase 1%
High Natural Gas Price	Natural gas price forecast	2x
Nuclear Retirement	Nuclear Retirement Date	Set nuclear retirement to relicense date
Fixed Capacity Value Curves	Declining Capacity Value Curves	Remove Curves
Unconstrained Build	Max Zonal Capacity by Technology	Remove Limits
Reduced Hydro	Monthly Hydro Energy	- 10%
Remove Zone J SCR	Zone J SCR Capacity	- 430 MW Summer, 320 MW Winter

Capacity Expansion Model Overview

Model Framework

- **Capacity expansion models simulate investment and retirement of resources to meet load, policy targets, and other operational/capacity constraints by optimizing over the entire 20-year study period for the NYCA only**
  - The capacity expansion model assumes linear expansion, which allows for partial build/retirement decisions
    - Capacity builds are assumed at the zonal level, such that a single generator by technology type can be built in each applicable zone
    - Economic retirements are enabled such that individual generators could retire in part or in its entirety within the overall optimization
- **The NYISO capacity expansion model uses 17 time slices per year to represent the 8,760-hour load and generation profiles**
  - For each year, 16 of the load blocks are represented by splitting hours of the year by season (Spring, Summer, Fall, Winter) and time of day (overnight, morning, afternoon, evening) and the 17th load block represents a period of peak load hours
  - The time slices capture seasonal and diurnal variation in wind, solar, and load profile
- **PLEXOS creates a reduced "pipe-and-bubble" model by performing a nodal to zonal reduction of the transmission system**

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Limitations

- The capacity expansion model was developed as an initial reasoned trade-off between balancing model fidelity, runtime, and future uncertainty/knowledge of input assumptions (characterized by scenario testing) to produce representations of outcomes of the future NY generation fleet and operations
- The capacity expansion modeling framework employed will not capture curtailment of renewable resources due to specific transmission constraints. Curtailments will be reported as part of the Policy Case production cost model results.
- Ongoing work will continue to refine the methods, assumptions, and reporting in the years to come

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Caveats

- The capacity expansion model is a projection of the future system mix and not an endorsement of outcomes under any specific set of assumptions. It is intended to inform NYISO studies and stakeholders of potential future generation buildouts under a multitude of scenarios
- The results of capacity expansion models are sensitive to the input assumptions related to cost and performance of resources and the modeling framework used to represent chronology and nodal/zonal representations
- The capacity expansion model does not capture capacity market dynamics beyond simplified assumptions of satisfying current published IRM and LCR requirements on an unforced capacity basis

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Caveats (cont.)

- A set of proxy generic Dispatchable Emission Free Resources (DEFRs) was used to approximate a range of capital and operating costs given uncertainty of future technology pathways to serve this role
- All DEFRs are modeled as highly flexible resources with operational parameters (*i.e.*, heat rate, ramp rate, reserve contribution, start time, etc.) similar to a new natural gas combined cycle (but with zero emission rate)
- While these proxy DEFR options may ultimately prove to not be representative of actual future technologies, they were used as a modeling framework to highlight the operational needs that would have to be met by the DEFRs when performing production cost simulations

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Summary of Baseline Assumptions

- CLCPA Case load forecast from 2021 Gold Book, with adjustments to BTM-PV, energy storage, and electrification forecasts
  - BTM-PV is included in the load forecast and is not modeled as a candidate technology eligible for capacity expansion
- CLCPA targets enforced (see next slide for list of modeled constraints)
- UCAP equivalent of IRM and LCR requirements enforced
- Generation resource investment and operating costs as outlined in the capacity expansion assumptions matrix
  - Capital, fixed O&M and variable O&M costs assumed per 2021 EIA Energy Outlook
  - Fuel and emissions prices consistent with production cost database
  - DEFR capital, fuel, and operating costs informed by recent studies
- Delay start year of new builds of certain technology types
  - No fossil builds prior to 2025
  - No DEFR or nuclear builds prior to 2035
- Max capacity limitations of UPV, LBW, and OSW aligned with 2040 limits per Appendix G: Annex 1: Inputs and Assumptions Climate Action Council draft scoping plan
- Declining capacity value curves for UPV, LBW, OSW, and ESR generators to model declining capacity value of these generators as a function of installed capacity

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Summary of Baseline Assumptions (cont.)

- **Candidate technologies eligible for capacity expansion:**
  - Land based wind
  - Offshore wind
  - Utility PV
  - 4-hour battery storage
  - Combined cycle
  - Combined cycle with 90% CCS
  - Nuclear
  - Internal combustion engine
  - Combustion turbine
  - Dispatchable Emission Free Resource (DEFR)

- **CLCPA targets and other state policy mandates modeled:**
  - 6 GW BTM-PV by 2025
  - 70% renewable energy by 2030
  - 3 GW energy storage by 2030
  - 10 GW BTM-PV by 2030
  - 9 GW offshore wind by 2035
  - 100% CO_2 emission free by 2040

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Preliminary Capacity Expansion Results

Initial Capacity Expansion Scenarios Conducted

Scenario	Assumption Adjusted	Value
High Natural Gas Price	Natural gas price forecast	2x
High CO_2	CO_2 price forecast	2x
Higher CO_2	CO_2 price forecast	10x
Low Renewable Technology Cost	Build cost for applicable technologies	Climate Action Council assumptions
Fixed Capacity Value Curves	Declining capacity value curves	Remove curves
Remove Zone J SCRs	Zone J SCR Capacity	Remove 430 MW Summer, 320 MW Winter

Note: Assumption changes included in the scenarios are not an endorsement or estimate of the validity of the values modified from the baseline assumptions. Some scenarios (e.g. Fixed Capacity Value Curves) do not represent realistic system performance but are helpful in identifying directional impacts and sensitivity to key variables.

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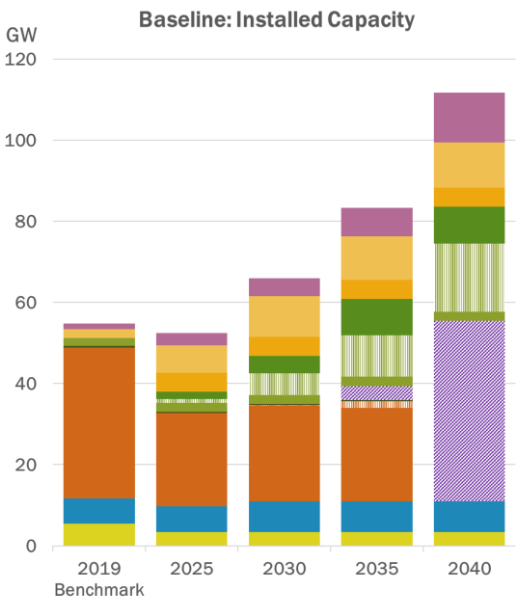
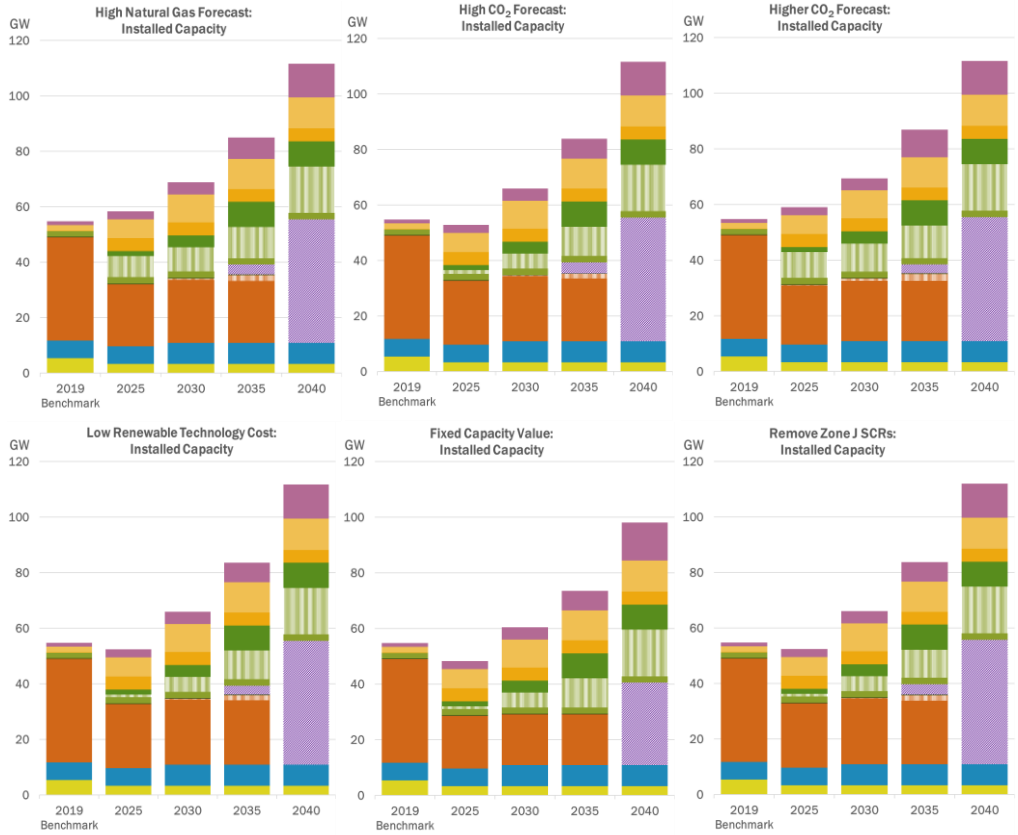
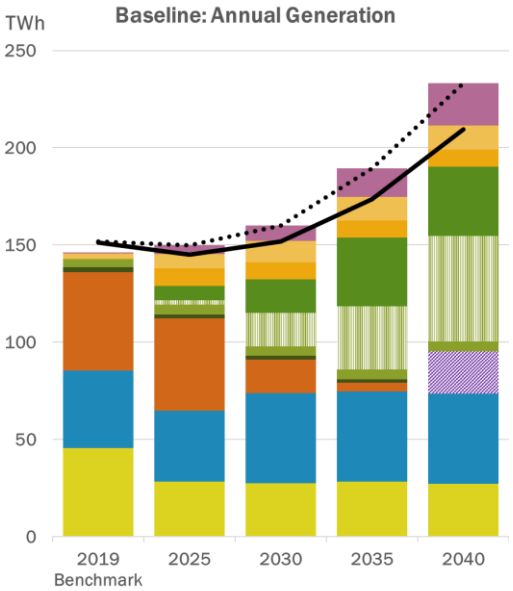
Preliminary Capacity Expansion Results

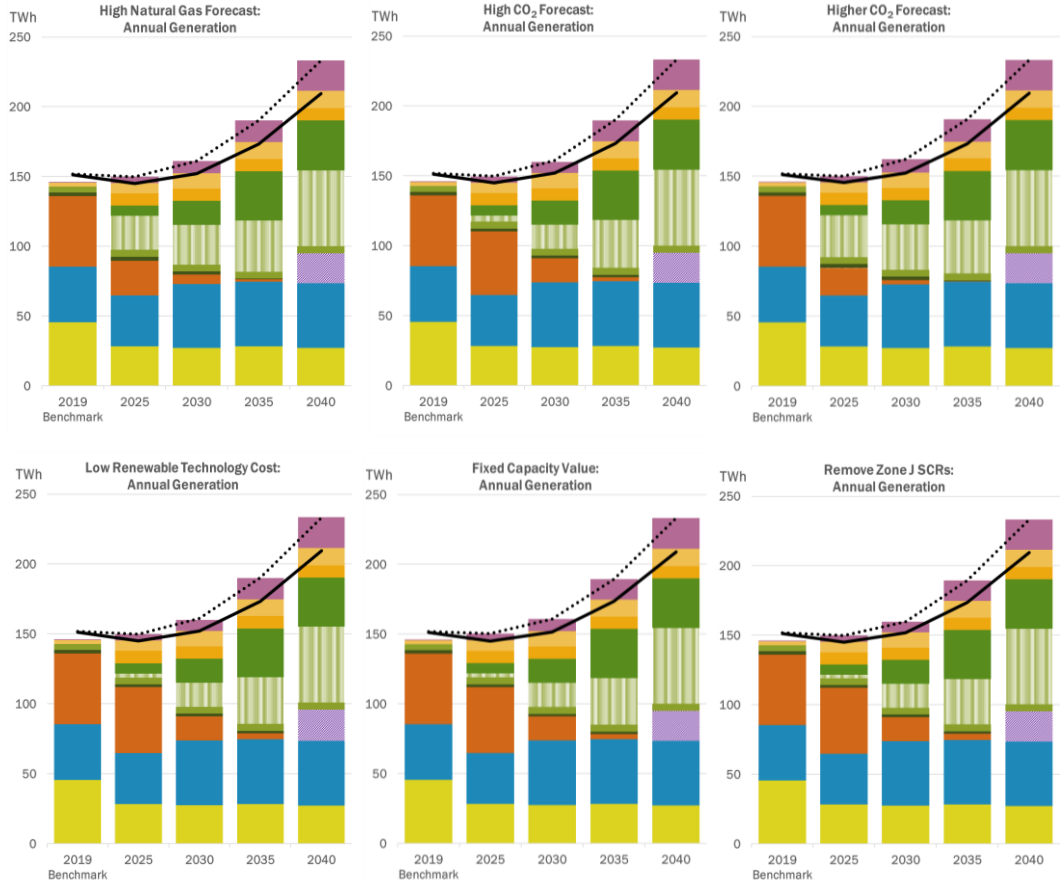




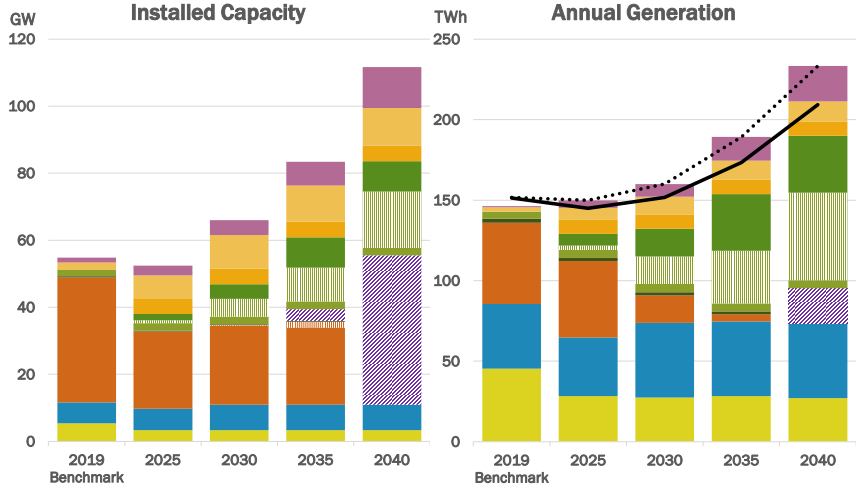
ExistingNuclear NewNuclear Hydro ExistingFossil NewFossil Other DEFR ExistingLBW NewLBW OSW UPV BTM-PV Storage

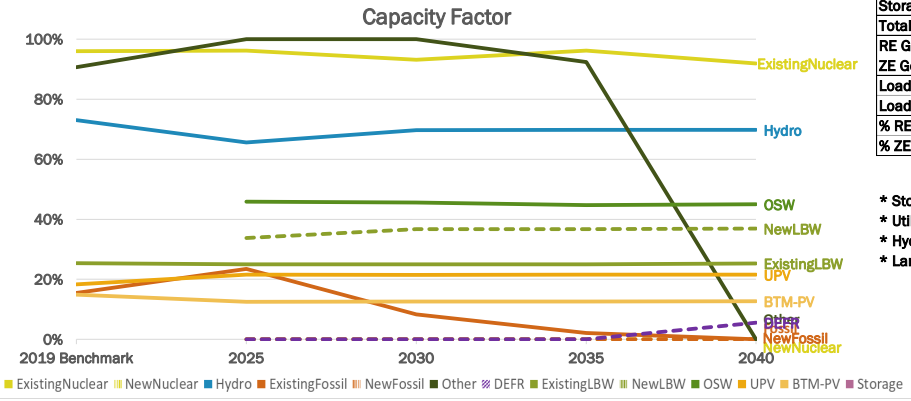
Preliminary Capacity Expansion Results





Baseline Capacity Expansion Results





Installed Capacity (MW)					
	2019	2025	2030	2035	2040
Nuclear	5,400	3,364	3,364	3,364	3,364
Fossil	37,262	23,076	23,739	24,723	-
DEFR	-	-	-	3,522	44,503
Hydro	6,257	6,335	7,585	7,588	7,588
LBW	1,985	3,138	7,612	12,415	19,087
OSW	-	1,826	4,316	9,000	9,000
UPV	32	4,676	4,676	4,676	4,676
BTM-PV	2,116	6,834	10,055	10,828	11,198
Storage	1,405	2,910	4,410	7,010	12,243
Total	54,764	52,383	65,983	83,351	111,660

Generation (GWh)					
	2019	2025	2030	2035	2040
Nuclear	45,429	28,338	27,444	28,338	27,092
Fossil	50,520	47,445	17,146	4,368	-
DEFR	-	-	-	-	21,815
Hydro	40,034	36,418	46,342	46,393	46,378
LBW	4,416	7,518	22,162	37,626	59,362
OSW	-	7,331	17,248	35,271	35,460
UPV	51	8,817	8,816	8,817	8,819
BTM-PV	2,761	7,483	11,068	11,983	12,454
Storage	612	4,598	7,854	14,682	21,951
Total Generation	146,262	149,938	160,057	189,300	233,330
RE Generation	47,261	67,567	105,636	140,090	162,472
ZE Generation	92,690	95,905	133,080	168,428	233,330
Load	151,386	144,953	151,756	173,460	209,374
Load+Charge	151,773	149,939	160,058	189,301	233,330
% RE [RE/Load]	31%	47%	70%	81%	78%
% ZE [ZE/(Load+Charge)]	61%	64%	83%	89%	100%

* Storage includes Pumped Storage Hydro and Batteries
* Utility solar (UPV) includes existing (77 MW) and new UPV
* Hydro includes hydro imports from Hydro Quebec
* Land-Based Wind (LBW), Offshore Wind (OSW), Zero Emissions (ZE)

Key Insights

- Capacity is built to achieve technology specific and overarching power sector policy targets, as well as energy and capacity requirements
- Renewable capacity builds occur earlier in model horizon, primarily LBW
- Decreased fossil capacity/ generation offset by DEFR built in mid- to late-2030s
- Increase in renewable capacity primarily supplied by LBW, UPV does not build beyond Contract Case resources, and OSW builds to reach the 9 GW 2035 target

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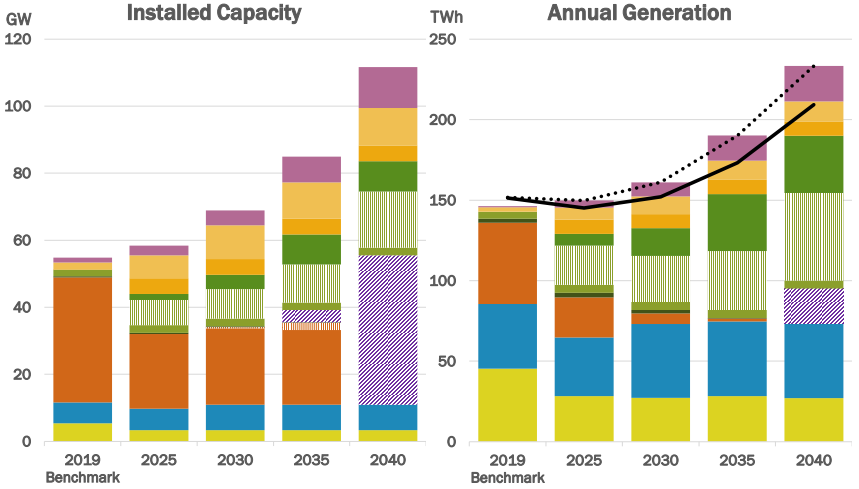
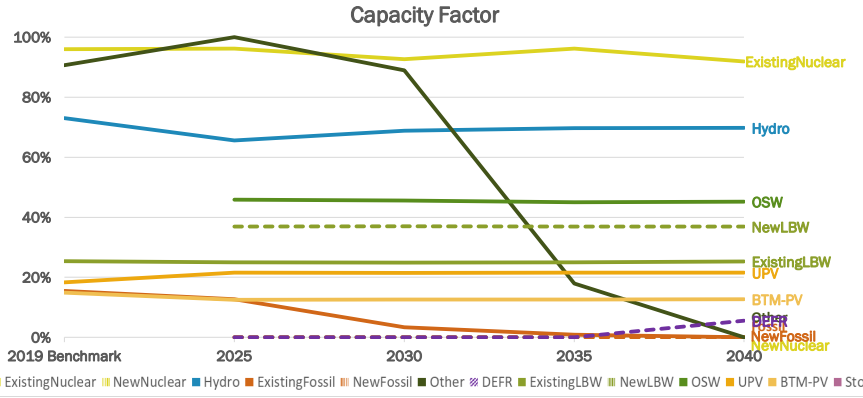
High Natural Gas Forecast





Installed Capacity (MW)	2019	2025	2030	2035	2040
Nuclear	5,400	3,364	3,364	3,364	3,364
Fossil	37,262	22,315	23,104	24,353	-
DEFR	-	-	-	3,617	44,508
Hydro	6,257	6,335	7,585	7,588	7,588
LBW	1,985	9,800	11,060	13,587	19,087
OSW	-	1,826	4,316	9,000	9,000
UPV	32	4,676	4,676	4,676	4,676
BTM-PV	2,116	6,834	10,055	10,828	11,198
Storage	1,405	2,910	4,410	7,712	12,228
Total	54,764	58,381	68,851	84,950	111,649

Generation (GWh)	2019	2025	2030	2035	2040
Nuclear	45,429	28,338	27,303	28,338	27,092
Fossil	50,520	24,851	6,657	1,799	-
DEFR	-	-	-	-	21,628
Hydro	40,034	36,418	45,719	46,359	46,378
LBW	4,416	29,316	33,440	41,539	59,362
OSW	-	7,331	17,248	35,460	35,647
UPV	51	8,817	8,816	8,817	8,819
BTM-PV	2,761	7,483	11,068	11,983	12,454
Storage	612	4,420	8,671	15,537	21,944
Total Generation	146,262	149,812	161,115	190,187	233,323
RE Generation	47,261	89,365	116,291	144,157	162,659
ZE Generation	92,690	117,703	143,594	172,496	233,323
Load	151,386	145,080	152,073	173,272	209,374
Load+Charge	151,773	149,813	161,115	190,187	233,323
% RE [RE/Load]	31%	62%	76%	83%	78%
% ZE [ZE/(Load+Charge)]	61%	79%	89%	91%	100%

* Storage includes Pumped Storage Hydro and Batteries
* Utility solar (UPV) includes existing (77 MW) and new UPV
* Hydro includes hydro imports from Hydro Quebec
* Land-Based Wind (LBW), Offshore Wind (OSW), Zero Emissions (ZE)

Input Assumption Adjusted:

Weekly Natural Gas price forecasts 2021-2040 System and Resource Outlook Fuel Forecast escalated 2x to produce high natural gas forecast

Key Insights:

- Similar trends as "High/Higher CO_2 forecast" scenarios
- Renewable capacity builds occur earlier in model horizon, primarily LBW
- Decrease in fossil generation
- Increase in renewable generation, primarily LBW, exceed 70% RE target in 2030

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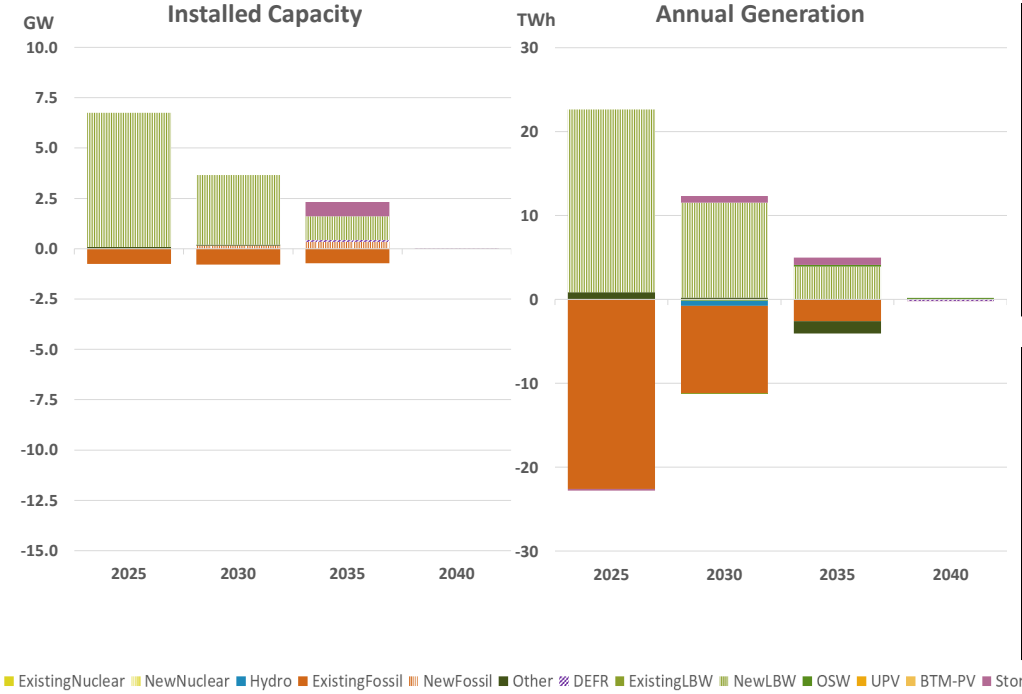
High Natural Gas Forecast – Delta from Baseline



Installed Capacity (MW)	2025	2030	2035	2040
Nuclear	-	-	-	-
Fossil	(761)	(635)	(370)	-
Other	97	56	-	-
DEFR	-	-	95	5
Hydro	-	-	-	-
LBW	6,662	3,448	1,172	-
OSW	-	-	-	-
UPV	-	-	-	-
BTM-PV	-	-	-	-
Storage	-	-	702	(16)
Total	5,998	2,869	1,599	(11)

Generation (GWh)	2025	2030	2035	2040
Nuclear	-	(141)	-	-
Fossil	(22,593)	(10,490)	(2,569)	-
Other	847	216	(1,467)	-
DEFR	-	-	-	(187)
Hydro	-	(623)	(33)	-
LBW	21,798	11,279	3,913	-
OSW	-	-	188	187
UPV	-	-	-	-
BTM-PV	-	-	-	-
Storage	(178)	817	855	(7)
Total Generation	(126)	1,057	886	(7)

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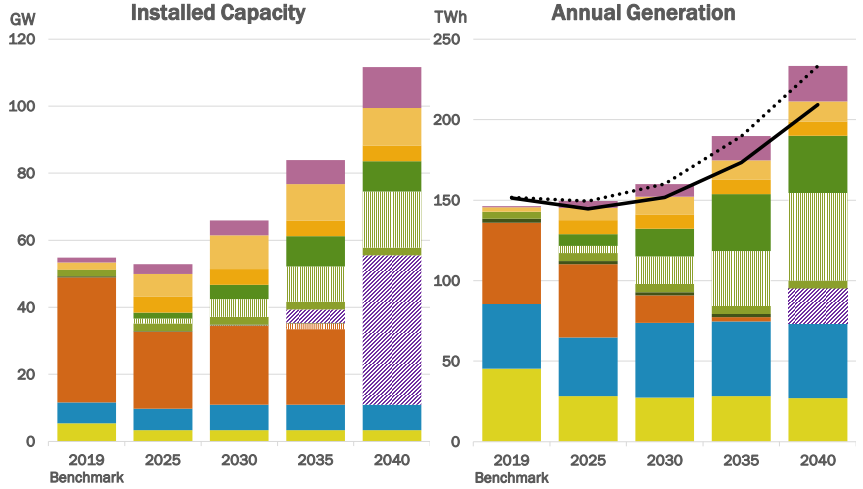
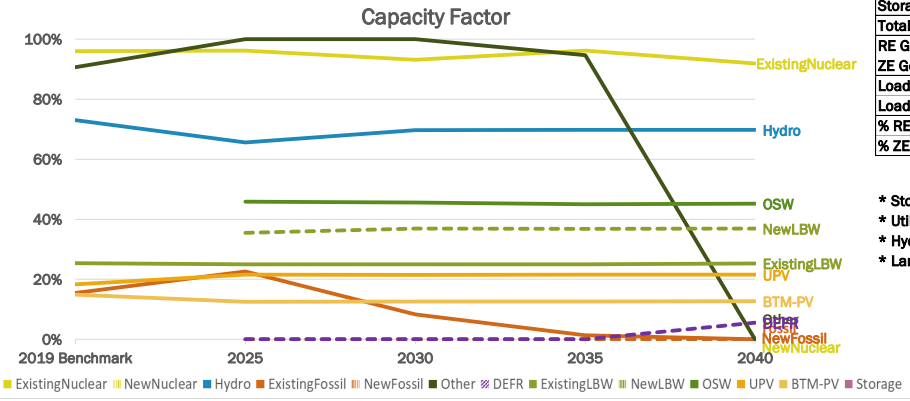
High CO_2 Forecast





Installed Capacity (MW)	2019	2025	2030	2035	2040
Nuclear	5,400	3,364	3,364	3,364	3,364
Fossil	37,262	22,981	23,643	24,184	-
DEFR	-	-	-	3,978	44,508
Hydro	6,257	6,335	7,585	7,588	7,588
LBW	1,985	3,677	7,596	12,855	19,087
OSW	-	1,826	4,316	9,000	9,000
UPV	32	4,676	4,676	4,676	4,676
BTM-PV	2,116	6,834	10,055	10,828	11,198
Storage	1,405	2,910	4,410	7,181	12,228
Total	54,764	52,826	65,870	83,880	111,649

Generation (GWh)	2019	2025	2030	2035	2040
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Fossil	50,520	45,462	17,130	2,699	-
DEFR	-	-	-	-	21,628
Hydro	40,034	36,418	46,342	46,393	46,378
LBW	4,416	9,325	22,162	39,115	59,362
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Storage	612	4,273	7,858	15,120	21,944
Total Generation	146,262	149,439	160,060	189,792	233,323
RE Generation	47,261	69,374	105,636	141,767	162,659
ZE Generation	92,690	97,712	133,080	170,105	233,323
Load	151,386	144,703	151,752	173,460	209,374
Load+Charge	151,773	149,439	160,061	189,792	233,323
% RE [RE/Load]	31%	48%	70%	82%	78%
% ZE [ZE/(Load+Charge)]	61%	65%	83%	90%	100%

* Storage includes Pumped Storage Hydro and Batteries
* Utility solar (UPV) includes existing (77 MW) and new UPV
* Hydro includes hydro imports from Hydro Quebec
* Land-Based Wind (LBW), Offshore Wind (OSW), Zero Emissions (ZE)

Input Assumption Adjusted:

Annual RGGI price forecast for 2021-2040 System and Resource Outlook Emission Allowance Price Forecast escalated 2x to produce a high CO_2 forecast

Key Insights:

- Renewable capacity builds occur earlier in model horizon, primarily LBW
- Decrease in fossil generation
- Increase in renewable generation, primarily LBW

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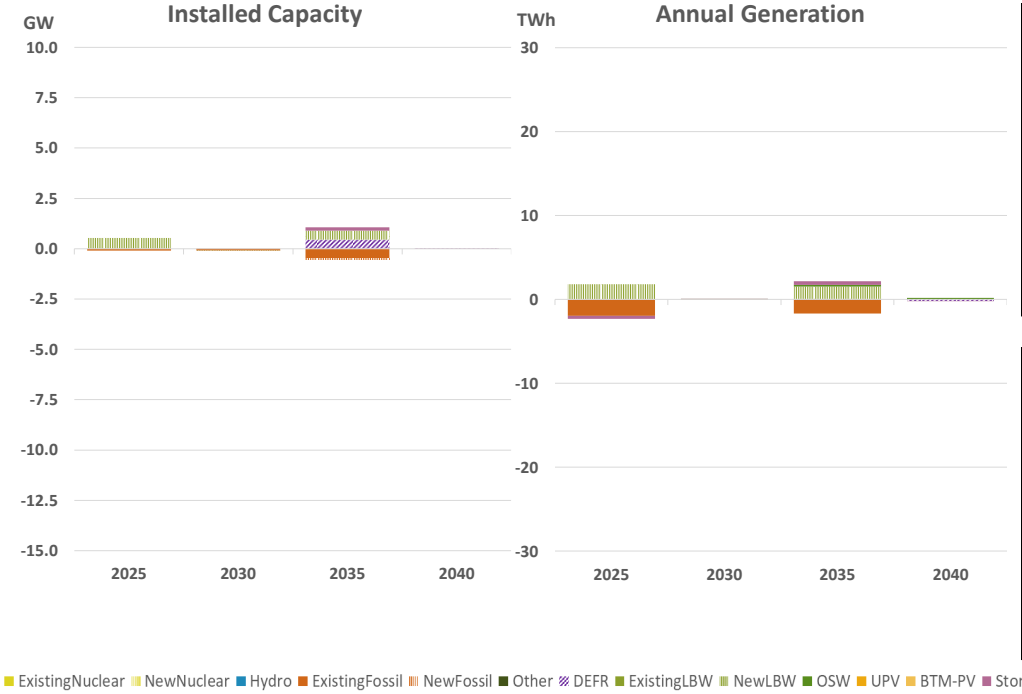
High CO_2 Forecast – Delta from Baseline



Installed Capacity (MW)	2025	2030	2035	2040
Nuclear	-	-	-	-
Fossil	(96)	(96)	(539)	-
Other	-	-	-	-
DEFR	-	-	456	5
Hydro	-	-	-	-
LBW	539	(17)	440	-
OSW	-	-	-	-
UPV	-	-	-	-
BTM-PV	-	-	-	-
Storage	-	-	171	(16)
Total	443	(112)	529	(11)

Generation (GWh)	2025	2030	2035	2040
Nuclear	-	-	-	-
Fossil	(1,982)	(16)	(1,669)	-
Other	-	15	45	-
DEFR	-	-	-	(187)
Hydro	-	-	-	-
LBW	1,807	-	1,489	-
OSW	-	-	188	187
UPV	-	-	-	-
BTM-PV	-	-	-	-
Storage	(325)	5	438	(7)
Total Generation	(500)	3	491	(7)

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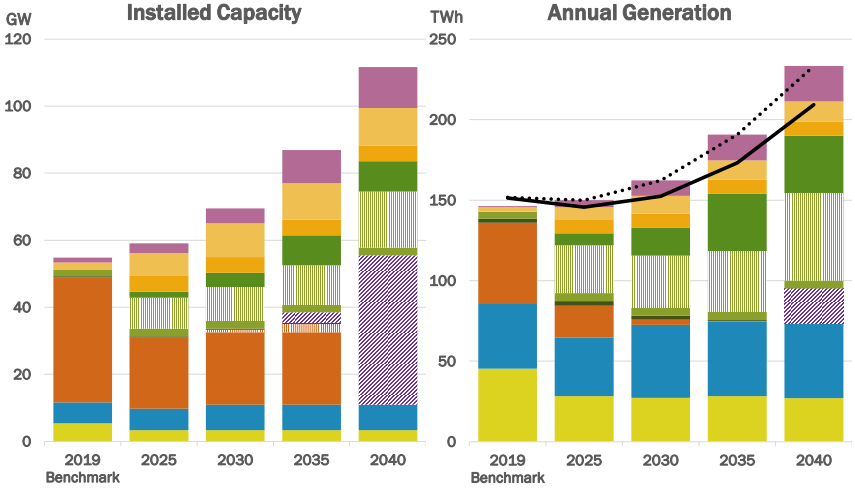
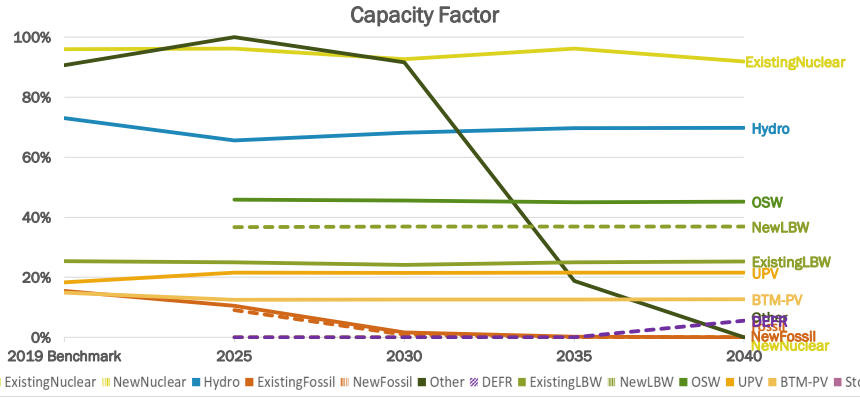
Higher CO_2 Forecast





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DEFR	-	-	-	3,132	44,508
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Generation (GWh)	2019	2025	2030	2035	2040
Nuclear	45,429	28,338	27,303	28,338	27,092
Fossil	50,520	19,664	3,116	372	-
DEFR	-	-	-	-	21,628
Hydro	40,034	36,418	45,313	46,359	46,378
LBW	4,416	34,800	37,355	42,895	59,362
OSW	-	7,331	17,248	35,460	35,647
UPV	51	8,817	8,805	8,817	8,819
BTM-PV	2,761	7,483	11,068	11,983	12,454
Storage	612	4,310	9,549	16,095	21,944
Total Generation	146,262	150,000	162,246	190,812	233,323
RE Generation	47,261	94,848	119,788	145,514	162,659
ZE Generation	92,690	123,186	147,091	173,852	233,323
Load	151,386	145,646	152,368	173,272	209,374
Load+Charge	151,773	150,001	162,247	190,813	233,323
% RE [RE/Load]	31%	65%	79%	84%	78%
% ZE [ZE/(Load+Charge)]	61%	82%	91%	91%	100%

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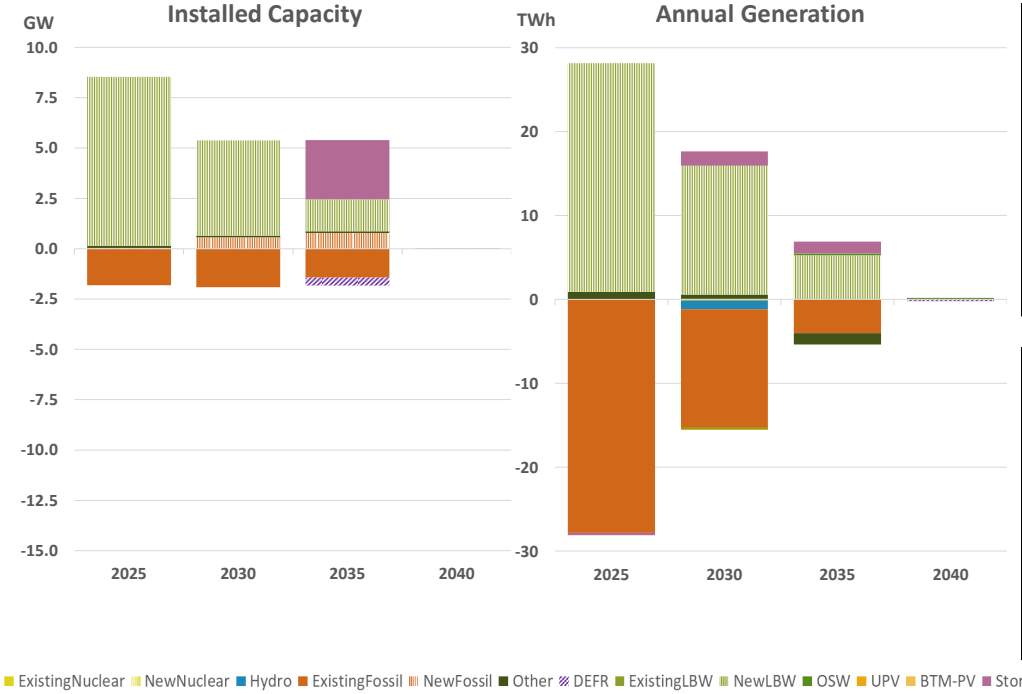
Input Assumption Adjusted:

Annual RGGI price forecast for 2021-2040 System and Resource Outlook Emission Allowance Price Forecast escalated 10x to produce a more extreme high CO_2 forecast

Key Insights:

- Similar trends as "High CO_2 forecast" scenario
- Renewable capacity builds occur earlier in model horizon, primarily LBW
- Energy storage capacity builds occur earlier in model horizon
- Decrease in fossil generation
- Increase in renewable generation, primarily LBW, exceed 70% RE target in 2030

Higher CO_2 Forecast – Delta from Baseline



Installed Capacity (MW)	2025	2030	2035	2040
Nuclear	-	-	-	-
Fossil	(1,781)	(1,357)	(647)	-
Other	97	85	74	-
DEFR	-	-	(390)	5
Hydro	-	-	-	-
LBW	8,401	4,738	1,589	-
OSW	-	-	-	-
UPV	-	-	-	-
BTM-PV	-	-	-	-
Storage	-	-	2,940	(16)
Total	6,716	3,465	3,565	(11)

Generation (GWh)	2025	2030	2035	2040
Nuclear	-	(141)	-	-
Fossil	(27,780)	(14,031)	(3,996)	-
Other	847	512	(1,329)	-
DEFR	-	-	-	(187)
Hydro	-	(1,030)	(33)	-
LBW	27,282	15,193	5,269	-
OSW	-	-	188	187
UPV	-	(12)	-	-
BTM-PV	-	-	-	-
Storage	(287)	1,696	1,413	(7)
Total Generation	61	2,189	1,512	(7)

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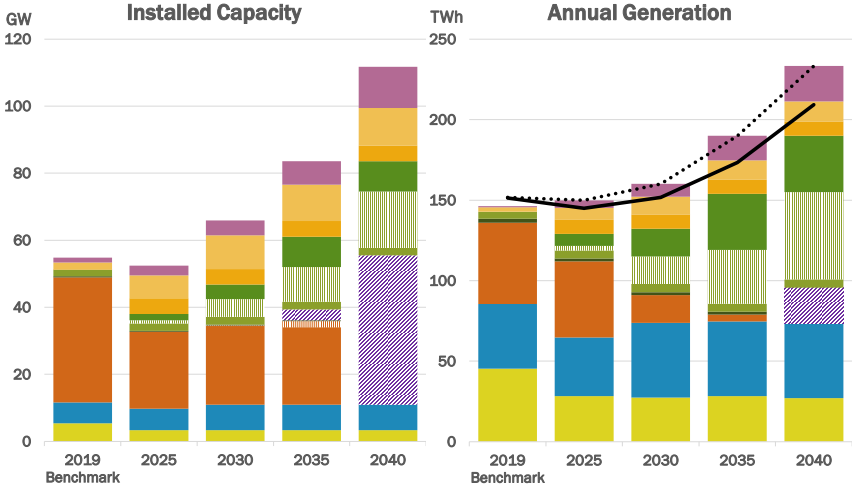
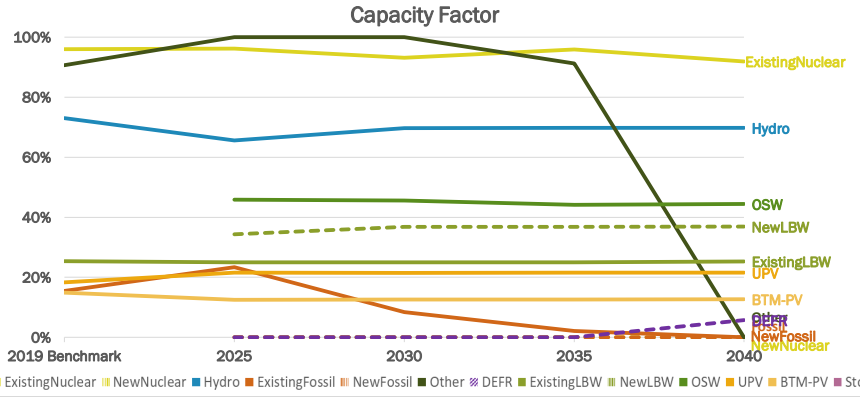
Low Renewable Technology Cost





Installed Capacity (MW)					
	2019	2025	2030	2035	2040
Nuclear	5,400	3,364	3,364	3,364	3,364
Fossil	37,262	22,997	23,659	24,901	-
DEFR	-	-	-	3,302	44,491
Hydro	6,257	6,335	7,585	7,588	7,588
LBW	1,985	3,236	7,602	12,648	19,087
OSW	-	1,826	4,316	9,000	9,000
UPV	32	4,676	4,676	4,676	4,676
BTM-PV	2,116	6,834	10,055	10,828	11,198
Storage	1,405	2,910	4,410	7,010	12,281
Total	54,764	52,391	65,882	83,532	111,686

Generation (GWh)					
	2019	2025	2030	2035	2040
Nuclear	45,429	28,338	27,444	28,261	27,092
Fossil	50,520	47,198	17,231	4,327	-
DEFR	-	-	-	-	22,274
Hydro	40,034	36,418	46,342	46,393	46,378
LBW	4,416	7,854	22,162	38,409	59,362
OSW	-	7,331	17,248	34,811	35,003
UPV	51	8,817	8,816	8,817	8,819
BTM-PV	2,761	7,483	11,068	11,983	12,454
Storage	612	4,593	7,924	15,273	21,967
Total Generation	146,262	149,929	160,118	189,987	233,348
RE Generation	47,261	67,902	105,636	140,413	162,015
ZE Generation	92,690	96,240	133,080	168,673	233,348
Load	151,386	144,944	151,718	173,467	209,374
Load+Charge	151,773	149,929	160,119	189,987	233,348
% RE [RE/Load]	31%	47%	70%	81%	77%
% ZE [ZE/(Load+Charge)]	61%	64%	83%	89%	100%

* Storage includes Pumped Storage Hydro and Batteries
* Utility solar (UPV) includes existing (77 MW) and new UPV
* Hydro includes hydro imports from Hydro Quebec
* Land-Based Wind (LBW), Offshore Wind (OSW), Zero Emissions (ZE)

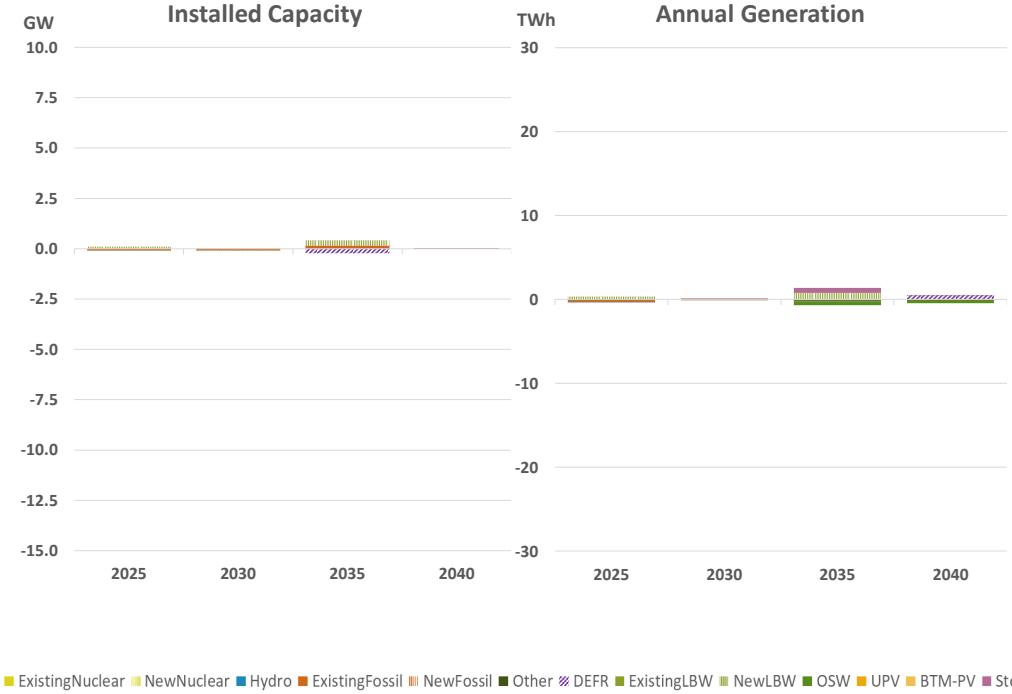
Input Assumption Adjusted:

Build cost for candidate renewable technologies for capacity expansion (UPV, LBW, and OSW) to align with Integration Analysis – Inputs and Assumptions Workbook

Key Insights:

- Capacity builds by technology type shift between zone(s)
- NYCA wide capacity builds and generation are generally comparable to case with other build cost assumptions

Low Renewable Technology Cost – Delta from Baseline



Installed Capacity (MW)	2025	2030	2035	2040
Nuclear	-	-	-	-
Fossil	(80)	(80)	178	-
Other	(11)	(11)	(11)	-
DEFR	-	-	(220)	(12)
Hydro	-	-	-	-
LBW	99	(10)	233	-
OSW	-	-	-	-
UPV	-	-	-	-
BTM-PV	-	-	-	-
Storage	-	-	-	38
Total	8	(101)	181	26

Generation (GWh)	2025	2030	2035	2040
Nuclear	-	-	(78)	-
Fossil	(247)	85	(41)	-
Other	(94)	(94)	(109)	-
DEFR	-	-	-	458
Hydro	-	-	-	-
LBW	336	-	784	-
OSW	-	-	(461)	(457)
UPV	-	-	-	-
BTM-PV	-	-	-	-
Storage	(4)	70	591	16
Total Generation	(10)	61	686	18

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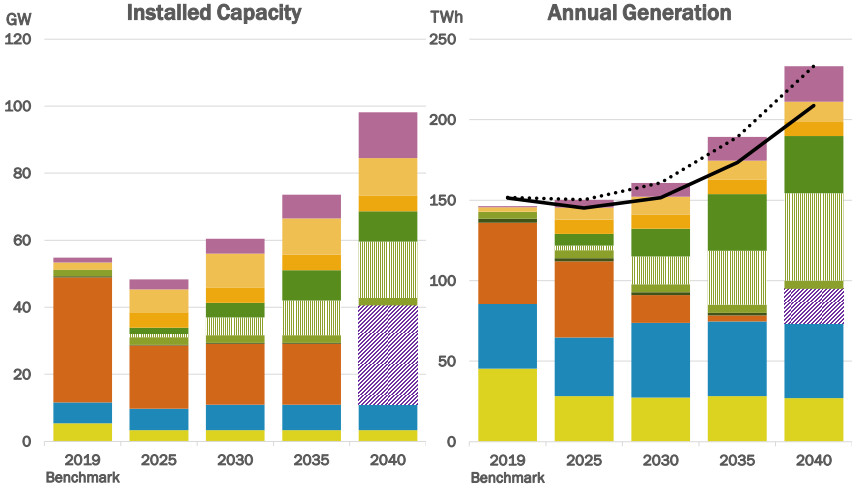
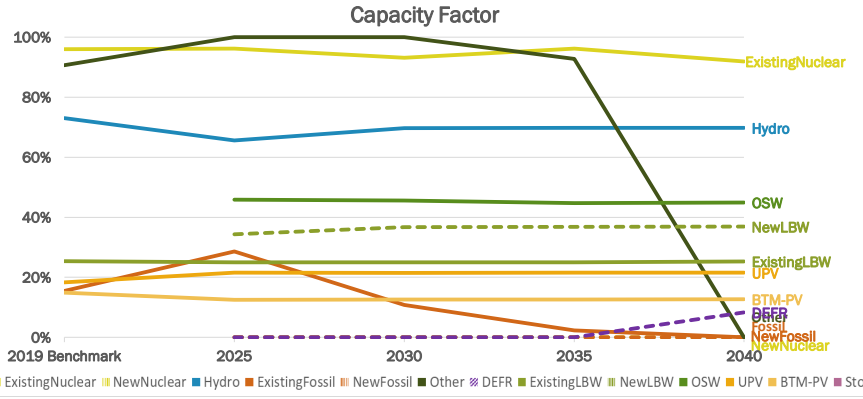
Fixed Capacity Value





Installed Capacity (MW)	2019	2025	2030	2035	2040
Nuclear	5,400	3,364	3,364	3,364	3,364
Fossil	37,262	18,885	18,191	18,193	-
DEFR	-	-	-	-	29,555
Hydro	6,257	6,335	7,585	7,588	7,588
LBW	1,985	3,236	7,612	12,662	19,087
OSW	-	1,826	4,316	9,000	9,000
UPV	32	4,676	4,676	4,676	4,676
BTM-PV	2,116	6,834	10,055	10,828	11,198
Storage	1,405	2,910	4,410	7,018	13,666
Total	54,764	48,276	60,420	73,541	98,135

Generation (GWh)	2019	2025	2030	2035	2040
Nuclear	45,429	28,338	27,444	28,338	27,092
Fossil	50,520	47,351	17,221	3,665	-
DEFR	-	-	-	-	21,566
Hydro	40,034	36,418	46,342	46,393	46,378
LBW	4,416	7,854	22,162	38,467	59,362
OSW	-	7,331	17,248	35,247	35,436
UPV	51	8,817	8,816	8,817	8,819
BTM-PV	2,761	7,483	11,068	11,983	12,454
Storage	612	4,850	8,596	14,699	22,181
Total Generation	146,262	150,305	160,761	189,319	233,287
RE Generation	47,261	67,902	105,636	140,907	162,448
ZE Generation	92,690	96,240	133,080	169,245	233,287
Load	151,386	145,108	151,526	173,460	208,823
Load+Charge	151,773	150,306	160,761	189,320	233,287
% RE [RE/Load]	31%	47%	70%	81%	78%
% ZE [ZE/(Load+Charge)]	61%	64%	83%	89%	100%

* Storage includes Pumped Storage Hydro and Batteries
* Utility solar (UPV) includes existing (77 MW) and new UPV
* Hydro includes hydro imports from Hydro Quebec
* Land-Based Wind (LBW), Offshore Wind (OSW), Zero Emissions (ZE)

Input Assumption Adjusted:

UCAP ratings of renewable and energy storage generators

Key Insights:

- Decrease in fossil capacity, primarily retirement of existing capacity but also decreased new fossil build, due to higher capacity values of renewable and energy storage generators' contribution to capacity requirements
- Reduction in the amount of DEFR capacity built to offset higher capacity valuation of similar RE buildout

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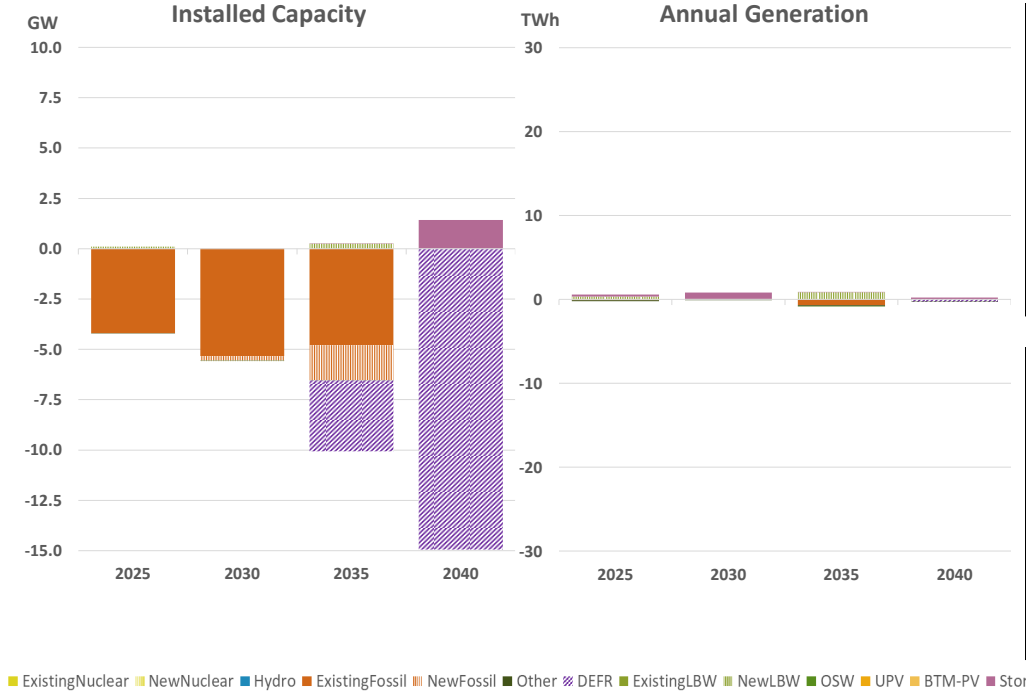
Fixed Capacity Value – Delta from Baseline



Installed Capacity (MW)	2025	2030	2035	2040
Nuclear	-	-	-	-
Fossil	(4,191)	(5,547)	(6,530)	-
Other	(15)	(15)	(15)	-
DEFR	-	-	(3,522)	(14,948)
Hydro	-	-	-	-
LBW	99	(0)	247	-
OSW	-	-	-	-
UPV	-	-	-	-
BTM-PV	-	-	-	-
Storage	-	-	8	1,423
Total	(4,108)	(5,562)	(9,811)	(13,525)

Generation (GWh)	2025	2030	2035	2040
Nuclear	-	-	-	-
Fossil	(94)	75	(704)	-
Other	(128)	(113)	(111)	-
DEFR	-	-	-	(249)
Hydro	-	-	-	-
LBW	336	-	841	-
OSW	-	-	(24)	(24)
UPV	-	-	-	-
BTM-PV	-	-	-	-
Storage	252	742	17	230
Total Generation	366	704	19	(43)

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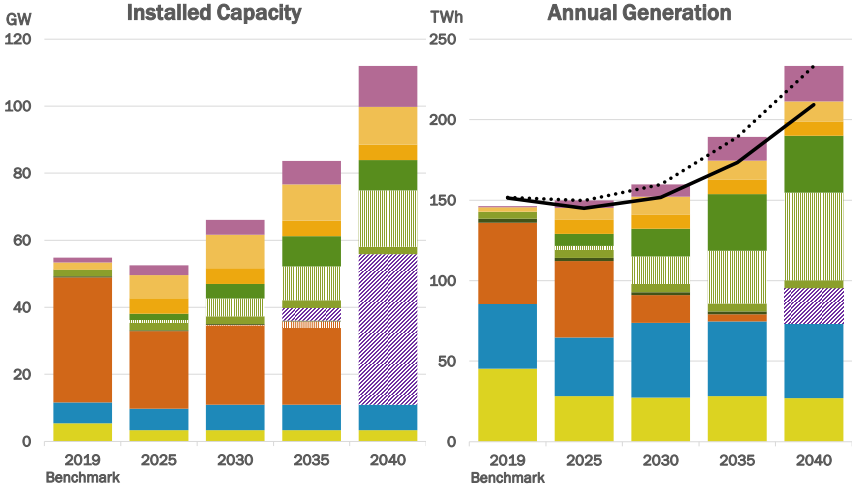
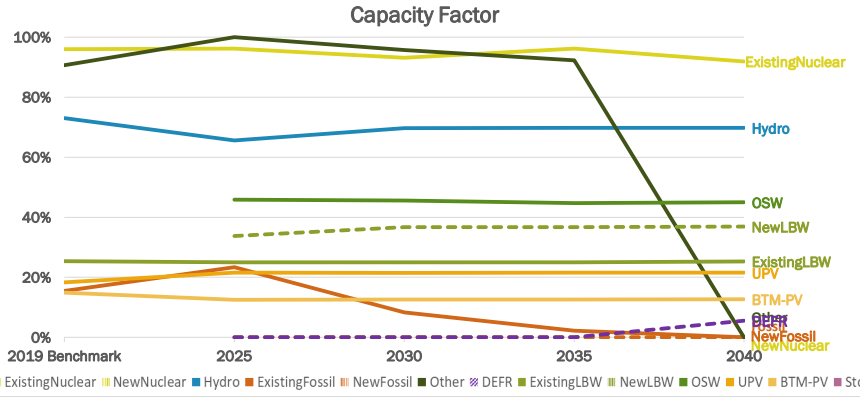
Remove Zone J SCRs





Installed Capacity (MW)	2019	2025	2030	2035	2040
Nuclear	5,400	3,364	3,364	3,364	3,364
Fossil	37,262	23,160	23,823	24,809	-
DEFR	-	-	-	3,774	44,836
Hydro	6,257	6,335	7,585	7,588	7,588
LBW	1,985	3,138	7,612	12,415	19,087
OSW	-	1,826	4,316	9,000	9,000
UPV	32	4,676	4,676	4,676	4,676
BTM-PV	2,116	6,834	10,055	10,828	11,198
Storage	1,405	2,910	4,410	7,010	12,243
Total	54,764	52,467	66,066	83,690	111,992

Generation (GWh)	2019	2025	2030	2035	2040
Nuclear	45,429	28,338	27,444	28,338	27,092
Fossil	50,520	47,409	17,221	4,364	-
DEFR	-	-	-	-	21,809
Hydro	40,034	36,418	46,342	46,393	46,378
LBW	4,416	7,518	22,162	37,626	59,362
OSW	-	7,331	17,248	35,277	35,466
UPV	51	8,817	8,816	8,817	8,819
BTM-PV	2,761	7,483	11,068	11,983	12,454
Storage	612	4,532	7,560	14,683	21,951
Total Generation	146,262	149,838	159,753	189,301	233,330
RE Generation	47,261	67,567	105,636	140,095	162,478
ZE Generation	92,690	95,905	133,080	168,433	233,330
Load	151,386	144,903	151,803	173,460	209,374
Load+Charge	151,773	149,838	159,753	189,302	233,330
% RE [RE/Load]	31%	47%	70%	81%	78%
% ZE [ZE/(Load+Charge)]	61%	64%	83%	89%	100%

* Storage includes Pumped Storage Hydro and Batteries
* Utility solar (UPV) includes existing (77 MW) and new UPV
* Hydro includes hydro imports from Hydro Quebec
* Land-Based Wind (LBW), Offshore Wind (OSW), Zero Emissions (ZE)

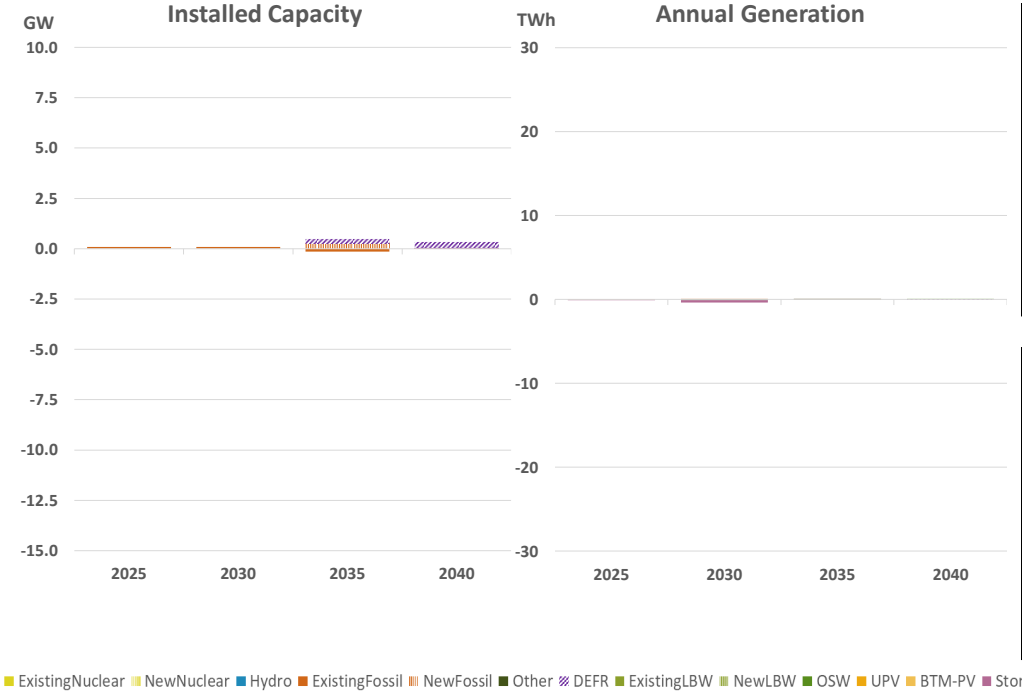
Input Assumption Adjusted:

Number of units of SCR generators in Zone J set to 0 (approximately 430 MW summer, 320 MW winter capacity)

Key Insights:

- Slight decrease in fossil retirements early in the model horizon
- Slight increase in DEFR capacity built

Remove Zone J SCRs – Delta from Baseline



Installed Capacity (MW)	2025	2030	2035	2040
Nuclear	-	-	-	-
Fossil	84	84	86	-
Other	-	-	-	-
DEFR	-	-	252	333
Hydro	-	-	-	-
LBW	-	-	-	-
OSW	-	-	-	-
UPV	-	-	-	-
BTM-PV	-	-	-	-
Storage	-	-	-	(0)
Total	84	84	338	333

Generation (GWh)	2025	2030	2035	2040
Nuclear	-	-	-	-
Fossil	(35)	74	(4)	-
Other	-	(85)	(1)	-
DEFR	-	-	-	(6)
Hydro	-	-	-	-
LBW	-	-	-	-
OSW	-	-	6	6
UPV	-	-	-	-
BTM-PV	-	-	-	-
Storage	(66)	(294)	1	(0)
Total Generation	(101)	(304)	1	(0)

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Next Steps

Next Steps

- **Comments due by 3/15**
- **3/24 ESPWG**
  - Capacity expansion scenario preliminary results
  - Contract Case
    - Congestion & Relaxation Analysis
    - Renewable generation pocket identification
    - Energy deliverability results

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Questions, Feedback, Comments?

- Email additional feedback to: JFrasier@nyiso.com

2021-2040 Outlook Data Catalog

ESPWG/TPAS 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

Final Reports

2022 Release

Data Posted to ESPWG

- Assumptions Matrix v1
- Capacity Expansion Assumptions Matrix v1
- Contract Case Renewable Projects
- Emissions Price Forecast
- Fuel Price Forecast
- Capacity Expansion Assumptions Matrix v2 (Redline)
- Capacity Expansion Assumptions Matrix v3 (Redline)
- Production Cost Assumptions Matrix v2 (Redline)
- Capacity Expansion Assumptions Matrix v4 (Redline)

New York ISO

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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