Caiazza Personal Comment Reconcile NYISO and Integration Analysis Capacity Projections

Summary
The New York Independent System Operator (NYISO) is currently (June 6, 2022) updating its System and Resource Outlook. The last Outlook Study Status presentation (April 26, 2022) noted that the draft report will be issued in June 2022. One of the supporting documents for this study is the Capacity Expansion Zonal Results Analysis spreadsheet. The projected new generating resources in the preliminary modeling results are different than the capacity additions in the Draft Scoping Plan Integration Analysis.

This comment documents the differences between the current preliminary draft NYISO capacity projections and the Draft Scoping Plan Integration Analysis. The point of this comment is that although the total generation capacity is pretty close between the analyses, the Climate Action Council and the NYISO have to reconcile four significant differences in the projections. The NYISO analysis projects dispatchable emissions-free resources capacity on the order twice as much as the three Integration Analysis mitigation scenarios. The NYISO analysis projects land-based wind capacity development about three times larger than the three Integration Analysis mitigation scenarios. The NYISO analysis projects off-shore wind capacity about 50% less than the three Integration Analysis mitigation scenarios. The NYISO analysis projects that solar will provide about one tenth the projected capacity of the three Integration Analysis mitigation scenarios.

The presentation notes it should be finalized this summer: "July 2022: Seek Board of Directors review and approval". When the NYISO report and projections are finalized the differences between the Integration Analysis and this report must be reconciled.

At one of this year's Climate Action Council meetings, I believe the idea of workshops to consider specific issues as suggested. I think this would be an ideal candidate topic for just such a meeting.

NYISO Outlook Study
The supporting documentation for the Outlook Study is the Capacity Expansion Zonal Results Analysis spreadsheet. The spreadsheet has two tables: Information and CapEx_Zonal_Builds. The builds table lists capacity additions (MW) for the baseline scenario and 27 analysis scenarios. As shown in the following table seven capacity expansion additions are included: Fossil, Nuclear, Utility-scale Photovoltaics (UPV), Land-Based Wind (LBW), Off-Shore Wind (OSW), Dispatchable Emissions-Free Resources (DEFR), and energy storage. Projections are included for two sets of New York Control Area zones and for the years 2030 and 2040. Note that the Climate Act mandates that in 2040 that all New York Electricity generation must be "zero-emissions".

Table 1: Example Capacity Expansion Zonal Results Analysis Spreadsheet Scenario Data

	Capacity Expansion Additions (MW)	2030		2040	
		A-E	F-K	A-E	F-K
Preliminary Baseline	Fossil	-	372	-	-
	Nuclear	-	-	-	-
	UPV	-	-	-	-
	LBW	6,442	397	14,451	1,498
	OSW	-	-	-	4,684
	DEFR	-	-	3,163	41,588
	Storage	1,317	1,673	4,282	5,745

I prepared a spreadsheet that extracted and merged the data from the CapEx_Zonal_Builds table for further analysis. The purpose of this analysis was not to evaluate and comment on the NYISO preliminary work. Instead, the goal was to compare these data to the Draft Scoping Plan Integration Analysis. I summed 2030 and 2040 data for both zone categories for each scenario because I think this represents the total capacity expansions through 2040. The Table 2 ("Summary" in my spreadsheet) lists the projections for all the NYISO Outlook Study scenarios.

Table 2: Summary of Capacity Expansion Total Zonal Result Additions (MW)

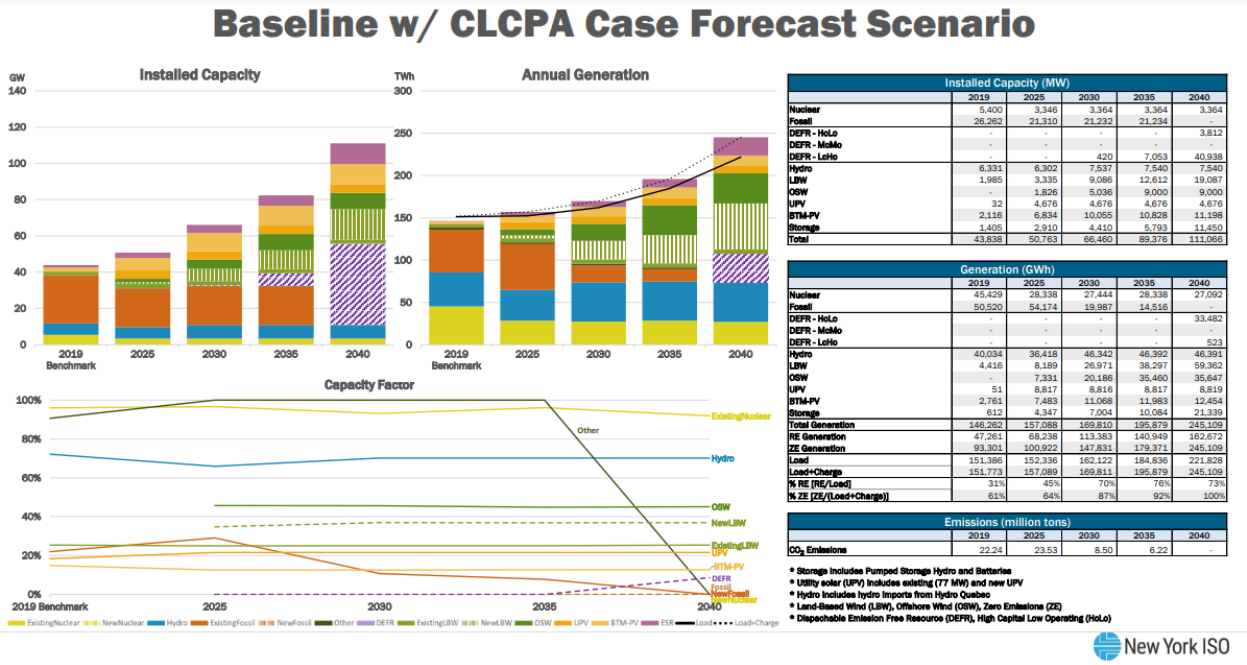
I summed 2030 and 2040 data for both zone categories.
I think this represents the total capacity through 2040.

Scenarios sorted by DEFR

Scenario	Fossil	Nuclear	UPV	LBW	OSW	DEFR	Storage	Total
Preliminary Baseline	372	-	-	22,789	4,684	44,751	13,017	85,614
Lower Load Forecast	-	-	2,065	16,702	4,684	20,934	7,317	51,703
Alternate Load Forecast	-	-	-	22,332	4,684	29,063	8,580	64,659
DEFR High Capital Costs	372	3,754	-	22,808	4,684	40,466	14,380	86,464
DEFR High Fuel Price	372	2,562	2,816	22,789	4,684	42,047	13,273	88,544
Unconstrained Renewable Builds	372	-	-	31,768	4,684	44,029	14,105	94,958
Low UPV, LBW, & OSW Capital Costs	372	-	15,324	25,803	4,684	44,326	14,380	104,889
Low UPV Capital Cost	372	-	18,306	21,505	4,684	44,332	14,380	103,579
No Fossil or Nuclear Builds Allowed	-	-	-	20,092	10,900	44,402	13,461	88,855
OSW Distribution J&K	372	-	-	19,955	7,178	44,738	13,059	85,303
Low LBW Capital Cost	372	-	-	25,883	4,684	44,746	13,035	88,720
Coppersheet Analysis	372	-	-	22,784	4,684	44,747	13,029	85,617
CPNY 75%	372	-	-	22,789	4,684	44,751	13,018	85,614
Increase ESR Policy Target	372	-	-	22,789	4,684	44,751	16,017	88,614
Decrease G-J 12%	372	-	-	22,789	4,684	44,751	13,017	85,614
CPNY 25%	372	-	-	22,789	4,684	44,751	13,017	85,614
DEFR Low Capital Costs	372	-	-	22,789	4,684	44,751	13,017	85,614
CPNY 50%	372	-	-	22,789	4,684	44,751	13,017	85,614
Decrease G-J 8%	372	-	-	22,789	4,684	44,751	13,017	85,614
DEFR High Heat Rate	372	-	-	22,789	4,684	44,751	13,017	85,614
Age Based Fossil Retirements	5,523	-	-	22,790	4,684	44,751	13,017	90,765
ESR Multipliers Zones J&K	372	-	-	22,789	4,684	44,751	13,017	85,614
Decrease G-J 4%	372	-	-	22,789	4,684	44,751	13,017	85,614
Low OSW Capital Cost	293	-	-	21,900	5,404	44,765	12,971	85,334
Reduced Hydro Output	372	-	-	23,609	4,684	44,841	12,730	86,236
DEFR Builds Allowed Starting in 2030	230	-	-	22,784	4,684	45,023	13,035	85,756
DEFR Low Fuel Price	372	-	-	20,266	4,684	46,011	9,315	80,647
Nuclear Retirements at Relicensing Date	372	-	-	22,789	4,684	46,806	13,133	87,784

NYISO Baseline with CLCPA Scenario

The last Outlook Study Status presentation (April 26, 2022) included a slide that is more compatible with the Integrated Analysis projections. The following slide (Figure 1) presents the Baseline w/ CLCPA Case Forecast Scenario installed capacity and annual generation estimates.



Installed Capacity (MW)	2019	2025	2030	2035	2040
Nuclear	5,400	3,346	3,364	3,364	3,364
Fossil	26,262	21,310	21,232	21,234	-
DEFR - HcLo	-	-	-	-	3,812
DEFR - McMo	-	-	-	-	-
DEFR - LcHo	-	-	420	7,053	40,938
Hydro	6,331	6,302	7,537	7,540	7,540
LBW	1,985	3,335	9,086	12,612	19,087
OSW	-	1,826	5,036	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	5,793	11,450
Total	43,838	50,763	66,460	89,376	111,066

Generation (GWh)	2019	2025	2030	2035	2040
Nuclear	45,429	28,338	27,444	28,338	27,092
Fossil	50,520	54,174	19,987	14,516	-
DEFR - HcLo	-	-	-	-	33,482
DEFR - McMo	-	-	-	-	-
DEFR - LcHo	-	-	-	-	523
Hydro	40,034	36,418	46,342	46,392	46,391
LBW	4,416	8,189	26,971	38,297	59,362
OSW	-	7,331	20,186	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	4,347	7,004	10,084	21,339
Total Generation	146,262	157,088	169,810	195,879	245,109
RE Generation	47,261	68,238	113,383	140,949	162,672
ZE Generation	93,301	100,922	147,831	179,371	245,109
Load	151,386	152,336	162,122	184,836	221,828
Load+Charge	151,773	157,089	169,811	195,879	245,109
% RE [RE/Load]	31%	45%	70%	76%	73%
% ZE [ZE/(Load+Charge)]	61%	64%	87%	92%	100%

Emissions (million tons)	2019	2025	2030	2035	2040
CO_2 Emissions	22.24	23.53	8.50	6.22	-

Figure 1: April 26, 2022 NYISO System and Resource Outlook Update Presentation, Slide 19

Table 3 lists the data in the tables on the right-hand side of the slide in a more legible format. It is important to note the caveats at the bottom of that section:

- Storage includes Pumped Storage Hydro and Batteries
- Utility solar (UPV) includes existing (77 MW) and new UPV
- Hydro includes hydro imports from Hydro Quebec
- Acronyms include the following:
  - Land-Based Wind (LBW)
  - Offshore Wind (OSW)
  - Zero Emissions (ZE)
  - Types of Dispatchable Emission Free Resource (DEFR):
    - High Capital, Low Operating (HcLo)
    - Medium Capital, Medium Operating (McMo)
    - Low Capital, High Operating (LcHo)

Table 3: NYISO System and Resource Outlook Update Presentation, Slide 19 Table Details

Installed Capacity (MW)					
	2019	2025	2030	2035	2040
Nuclear	5,400	3,346	3,364	3,364	3,364
Fossil	26,262	21,310	21,232	21,234	-
DEFR - HcLo	-	-	-	-	3,812
DEFR - McMo	-	-	-	-	-
DEFR - LcHo	-	-	420	7,053	40,938
Hydro	6,331	6,302	7,537	7,540	7,540
LBW	1,985	3,335	9,086	12,612	19,087
OSW	-	1,826	5,036	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	5,793	11,450
Total	43,838	50,763	66,460	89,376	111,066

Generation (GWh)					
	2019	2025	2030	2035	2040
Nuclear	45,429	28,338	27,444	28,338	27,092
Fossil	50,520	54,174	19,987	14,516	-
DEFR - HcLo	-	-	-	-	33,482
DEFR - McMo	-	-	-	-	-
DEFR - LcHo	-	-	-	-	523
Hydro	40,034	36,418	46,342	46,392	46,391
LBW	4,416	8,189	26,971	38,297	59,362
OSW	-	7,331	20,186	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	4,347	7,004	10,084	21,339
Total Generation	146,262	157,088	169,810	195,879	245,109
RE Generation	47,261	68,238	113,383	140,949	162,672
ZE Generation	93,301	100,922	147,831	179,371	245,109
Load	151,386	152,336	162,122	184,836	221,828
Load+Charge	151,773	157,089	169,811	195,879	245,109
% RE [RE/Load]	31%	45%	70%	76%	73%
% ZE [ZE/(Load+Charge)]	61%	64%	87%	92%	100%

Emissions (million tons)					
	2019	2025	2030	2035	2040
CO_2 Emissions	22.24	23.53	8.50	6.22	-

Draft Scoping Plan Integration Analysis

The Draft Scoping Plan Appendix G: Integration Analysis Technical Supplement "summarizes, reports, and documents the findings, results, and methodology of the Integration Analysis developed to support the Climate Action Council in its development of the Draft Scoping Plan pursuant to the Climate Act". At least that is how it is described. In reality, the documentation does not provide enough information to enable a reviewer to reproduce the findings and results.

According to § 75-0103 (14)(b) of the Climate Act detailed cost information is required: "Evaluate, using the best available economic models, emission estimation techniques and other scientific methods, the total potential costs and potential economic and non-economic benefits of the plan for reducing greenhouse gases, and make such evaluation publicly available". In order to meet that requirement, I believe that all control measures should be listed, with the assumptions used, with the costs and expected emission reductions for each one provided. Appendix G and the two supporting spreadsheets do not include sufficient information to satisfy that requirement.

For this analysis I relied on data in the Appendix G: Annex 2: Key Drivers and Outputs spreadsheet. Table 4 lists the installed capacity and Table 5 the annual generation for the three mitigation scenarios.

Table 4: Summary of Mitigation Scenarios Fuel Mix Installed Capacity (MW)
Appendix G: Annex 2: Key Drivers and Outputs

Scenario 2	Unit	2020	2025	2030	2035	2040	2045	2050
Nuclear	MW	4,860	3,355	3,355	3,355	3,355	3,355	2,135
Gas & FO	MW	26,388	25,775	21,579	18,078	-	-	-
Zero-Carbon Firm Resource	MW	-	-	-	-	21,015	21,576	21,290
Biomass	MW	327	327	327	327	327	275	178
In-State Hydro	MW	4,269	4,269	4,610	4,610	4,613	4,613	4,613
Hydro Imports (Existing)	MW	1,485	1,485	1,485	1,485	1,485	1,485	1,485
Hydro Imports (New)	MW	-	-	1,250	1,250	1,250	1,250	1,250
Wind	MW	1,917	3,292	3,814	4,263	5,845	7,781	9,445
Wind Imports	MW	-	-	1,760	5,796	6,397	6,397	6,397
Wind_Offshore	MW	-	1,826	6,200	9,906	14,364	16,393	16,393
Solar	MW	2,592	8,201	18,852	28,994	43,432	53,089	64,621
Battery Storage	MW	750	1,500	3,000	5,791	10,713	17,046	21,465
Pumped Storage	MW	1,435	1,435	1,435	1,435	1,435	1,435	1,435

Scenario 3	Unit	2020	2025	2030	2035	2040	2045	2050
Nuclear	MW	4,860	3,355	3,355	3,355	3,355	3,355	2,135
Gas & FO	MW	26,388	25,775	22,398	14,292	-	-	-
Zero-Carbon Firm Resource	MW	-	-	-	5,489	23,522	25,230	25,359
Biomass	MW	327	327	327	327	327	275	178
In-State Hydro	MW	4,269	4,269	4,610	4,613	4,613	4,613	4,613
Hydro Imports (Existing)	MW	1,485	1,485	1,485	1,485	1,485	1,485	1,485
Hydro Imports (New)	MW	-	-	1,250	1,250	1,250	1,250	1,250
Wind	MW	1,917	3,292	4,600	5,220	6,126	8,250	10,154
Wind Imports	MW	-	-	2,421	5,448	6,397	6,593	6,593
Wind_Offshore	MW	-	1,826	6,600	10,423	16,756	19,278	19,278
Solar	MW	2,592	8,201	16,762	28,625	41,420	49,042	60,604
Battery Storage	MW	750	1,500	3,000	8,090	12,207	16,383	19,212
Pumped Storage	MW	1,435	1,435	1,435	1,435	1,435	1,435	1,435

Scenario 4	Unit	2020	2025	2030	2035	2040	2045	2050
Nuclear	MW	4,860	3,355	3,355	3,355	3,355	3,355	2,135
Gas & FO	MW	26,388	25,775	21,579	20,326	-	-	-
Zero-Carbon Firm Resource	MW	-	-	-	-	23,676	24,333	24,048
Biomass	MW	327	327	327	327	327	275	178
In-State Hydro	MW	4,269	4,269	4,610	4,613	4,613	4,613	4,613
Hydro Imports (Existing)	MW	1,485	1,485	1,485	1,485	1,485	1,485	1,485
Hydro Imports (New)	MW	-	-	1,250	1,250	1,250	1,250	1,250
Wind	MW	1,917	3,292	3,859	4,491	6,282	8,305	11,052
Wind Imports	MW	-	-	2,649	5,970	6,397	6,397	6,397
Wind_Offshore	MW	-	1,826	6,600	9,967	15,875	18,066	18,310
Solar	MW	2,592	8,201	18,060	29,841	41,623	53,450	65,210
Battery Storage	MW	750	1,500	3,000	6,311	11,576	18,973	22,956
Pumped Storage	MW	1,435	1,435	1,435	1,435	1,435	1,435	1,435

Table 5: Summary of Mitigation Scenarios Annual Fuel Mix Generation (GWh)

Appendix G: Annex 2: Key Drivers and Outputs

Scenario 2	Unit	2020	2025	2030	2035	2040	2045	2050
Nuclear	GWh	38,318	26,452	26,452	26,452	26,452	26,452	16,835
Gas & FO	GWh	70,449	58,305	24,562	19,651	-	-	-
Zero-Carbon Firm Resource	GWh	-	-	-	-	3,342	3,675	4,153
Biomass	GWh	2,721	2,721	2,721	2,721	2,721	2,288	1,480
In-State Hydro	GWh	27,121	27,011	30,857	30,963	30,045	30,021	30,009
Hydro Imports (Existing)	GWh	10,361	10,361	10,361	10,361	10,361	10,361	10,361
Hydro Imports (New)	GWh	-	-	8,760	8,760	8,760	8,760	8,760
Wind	GWh	4,796	8,238	9,873	11,229	16,035	21,854	26,936
Wind Imports	GWh	-	-	6,944	22,810	25,130	24,916	24,931
Wind_Offshore	GWh	-	7,611	25,657	41,016	59,778	68,287	68,522
Solar	GWh	3,908	13,087	32,965	52,781	80,620	100,948	125,292
Battery Storage	GWh	(16)	47	(774)	(1,543)	(2,196)	(3,406)	(4,319)
Pumped Storage	GWh	(74)	(50)	(233)	(123)	(348)	(380)	(476)
Imports*	GWh	**4,694**	**3,827**	**2,309**	**4,573**	**13,545**	**14,266**	**14,818**
Exports	GWh	**(3,320)**	**(6,628)**	**(10,716)**	**(13,458)**	**(13,545)**	**(14,266)**	**(14,818)**
Load	GWh	**158,963**	**150,985**	**169,744**	**216,201**	**260,708**	**293,786**	**312,488**

Scenario 3	Unit	2020	2025	2030	2035	2040	2045	2050
Nuclear	GWh	38,318	26,452	26,452	26,452	26,452	26,452	16,835
Gas & FO	GWh	70,461	57,869	25,668	21,231	-	-	-
Zero-Carbon Firm Resource	GWh	-	-	-	-	4,440	5,419	6,399
Biomass	GWh	2,721	2,721	2,721	2,721	2,721	2,288	1,480
In-State Hydro	GWh	27,121	26,995	30,870	30,993	29,982	29,996	29,997
Hydro Imports (Existing)	GWh	10,361	10,361	10,361	10,361	10,361	10,361	10,361
Hydro Imports (New)	GWh	-	-	8,760	8,760	8,760	8,760	8,760
Wind	GWh	4,796	8,238	12,296	14,130	16,799	23,200	28,947
Wind Imports	GWh	-	-	9,544	21,389	25,002	25,563	25,546
Wind_Offshore	GWh	-	7,611	27,293	43,153	69,388	79,540	80,046
Solar	GWh	3,908	13,087	28,596	51,328	75,966	92,094	116,044
Battery Storage	GWh	(16)	66	(822)	(1,875)	(2,443)	(3,249)	(4,081)
Pumped Storage	GWh	(74)	(64)	(223)	(115)	(288)	(310)	(395)
Imports*	GWh	**4,695**	**3,832**	**3,330**	**5,005**	**13,978**	**14,459**	**15,073**
Exports	GWh	**(3,319)**	**(6,657)**	**(11,480)**	**(14,461)**	**(13,978)**	**(14,459)**	**(15,073)**
Load	GWh	**158,973**	**150,512**	**173,371**	**219,076**	**267,143**	**300,115**	**319,942**

Scenario 4	Unit	2020	2025	2030	2035	2040	2045	2050
Nuclear	GWh	38,318	26,452	26,452	26,452	26,452	26,452	16,835
Gas & FO	GWh	70,459	58,124	25,587	20,850	-	-	-
Zero-Carbon Firm Resource	GWh	-	-	-	-	4,644	5,614	6,609
Biomass	GWh	2,721	2,721	2,721	2,721	2,721	2,288	1,480
In-State Hydro	GWh	27,121	27,000	30,867	30,994	30,023	30,008	30,006
Hydro Imports (Existing)	GWh	10,361	10,361	10,361	10,361	10,361	10,361	10,361
Hydro Imports (New)	GWh	-	-	8,760	8,760	8,760	8,760	8,760
Wind	GWh	4,796	8,238	9,966	11,856	17,274	23,376	31,606
Wind Imports	GWh	-	-	10,449	23,455	25,035	24,849	24,811
Wind_Offshore	GWh	-	7,611	27,293	41,237	65,700	74,600	76,263
Solar	GWh	3,908	13,087	31,293	53,921	76,465	101,267	125,980
Battery Storage	GWh	(16)	61	(812)	(1,781)	(2,381)	(3,844)	(4,823)
Pumped Storage	GWh	(74)	(59)	(220)	(163)	(345)	(306)	(426)
Imports*	GWh	**4,694**	**3,834**	**3,303**	**5,017**	**14,006**	**14,780**	**15,101**
Exports	GWh	**(3,318)**	**(6,628)**	**(10,779)**	**(14,092)**	**(14,006)**	**(14,780)**	**(15,101)**
Load	GWh	**158,973**	**150,804**	**175,245**	**219,593**	**264,712**	**303,431**	**327,470**

Comparison

The capacity (MW) and generation (GWh) for the NYISO outlook study baseline with CLCPA case forecast scenario and integration analysis mitigation scenarios were combined in a spreadsheet as shown in Table 6. The point of this comment is that although the total generation capacity is pretty close between the analyses, the Climate Action Council and the NYISO have to reconcile four significant differences in the projections. The NYISO analysis projects dispatchable emissions-free resources capacity on the order twice as much as the three Integration Analysis mitigation scenarios. The NYISO analysis projects land-based wind capacity development about three times larger than the three Integration Analysis mitigation scenarios. The NYISO analysis projects off-shore wind capacity about 50% less than the three Integration Analysis mitigation scenarios. The NYISO analysis projects that solar will provide about one tenth the projected capacity of the three Integration Analysis mitigation scenarios.

It is beyond the scope of these comments to try to explain the reasons for these significant differences. Apparently, the analysts at NYISO and NYSERDA's consultants approached the problem differently. However, given the importance of future generating resources to electric system reliability and affordability, understanding the reason for the differences and which approach is appropriate for New York's Climate Act Energy Plan is absolutely necessary.

At one of this year's Climate Action Council meetings, I believe the idea of workshops to consider specific issues as suggested. I think this would be an ideal candidate topic for just such a meeting.

I prepared this comment because I believe that the biggest shortcoming in the Draft Scoping Plan is the lack of emphasis on reliability. The Final Scoping Plan will "shall inform the state energy planning board's adoption of a state energy plan" but the Climate Action Council membership is generally lacking the background, experience, and education to decide technical matters such as the fuel mix of the future generating system. Thomas Sowell said "It is hard to imagine a more stupid or more dangerous way of making decisions than by putting those decisions in the hands of people who pay no price for being wrong". Because the NYISO is responsible for reliability I believe that their analysis is preferable unless I can be convinced otherwise. I have written extensively on implementation of the Climate Act because I believe the ambitions for a zero-emissions economy outstrip available renewable technology such that it will adversely affect reliability and affordability, risk safety, affect lifestyles, will have worse impacts on the environment than the purported effects of climate change in New York, and cannot measurably affect global warming when implemented. The opinions expressed in this document do not reflect the position of any of my previous employers or any other company I have been associated with, these comments are mine alone.

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Table 6: Comparison of NYISO Baseline w/ CLCPA Case Forecast Scenario to Integration Analysis Mitigation Scenarios

NYISO Outlook Study Baseline with CLCPA Case Forecast Scenario and Integration Analysis Mitigation Scenarios Installed Capacity (MW)

	NYISO Baseline w/ CLCPA Case			Strategic Use of Low-Carbon Fuels			Accelerated Transition from Combustion			Beyond 85% Reduction		
Resource	2019	2030	2040	2020	2030	2040	2020	2030	2040	2020	2030	2040
Nuclear	5,400	3,364	3,364	4,860	3,355	3,355	4,860	3,355	3,355	4,860	3,355	3,355
Fossil	26,262	21,232	0	26,388	21,579	0	26,388	22,398	0	26,388	21,579	0
DEFR	0	420	44,750	0	0	21,015	0	0	23,522	0	0	23,676
Hydro	6,331	7,537	7,540	5,754	7,345	7,348	5,754	7,345	7,348	5,754	7,345	7,348
LBW	1,985	9,086	19,087	1,917	3,814	5,845	1,917	4,600	6,126	1,917	3,859	6,282
OSW	0	5,036	9,000	0	6,200	14,364	0	6,600	16,756	0	6,600	15,875
Solar	2,148	4,676	4,676	2,592	18,852	43,432	2,592	16,762	41,420	2,592	18,060	41,623
Storage	1,405	4,410	11,450	2,185	4,435	12,149	2,185	4,435	13,642	2,185	4,435	13,012
Other				327	327	327	327	327	327	327	327	327
Total	43,531	55,761	99,867	44,023	65,907	107,835	44,023	65,823	112,497	44,023	65,561	111,499

NYISO Outlook Study Baseline with CLCPA Case Forecast Scenario and Integration Analysis Mitigation Scenarios Generation (GWhr)

	NYISO Baseline w/ CLCPA Case			Strategic Use of Low-Carbon Fuels			Accelerated Transition from Combustion			Beyond 85% Reduction		
Resource	2019	2030	2040	2020	2030	2040	2020	2030	2040	2020	2030	2040
Nuclear	45,429	27,444	27,092	38,318	26,452	26,452	38,318	26,452	26,452	38,318	26,452	26,452
Fossil	50,520	19,987	0	70,449	24,562	0	70,461	25,668	0	70,459	25,587	0
DEFR	0	0	34,005	0	0	3,342	0	0	4,440	0	0	4,644
Hydro	40,034	46,342	46,391	37,481	49,978	49,165	37,482	49,991	49,103	37,482	49,987	49,144
LBW	4,416	26,971	59,362	4,796	9,873	16,035	4,796	12,296	16,799	4,796	9,966	17,274
OSW	0	20,186	35,647	0	25,657	59,778	0	27,293	69,388	0	27,293	65,700
Solar	2,812	8,816	8,819	3,908	32,965	80,620	3,908	28,596	75,966	3,908	31,293	76,465
Storage	612	7,004	21,339	-90	-1,007	-2,543	-90	-1,045	-2,730	-90	-1,032	-2,726
Other				2,721	2,721	2,721	2,721	2,721	2,721	2,721	2,721	2,721
Total	143,823	156,750	232,655	157,584	171,201	235,571	157,596	171,973	242,139	157,594	172,268	239,675

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