NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

In the Matter of a Renewal and Modification of a State Pollutant Discharge Elimination System ("SPDES") Permit Pursuant to article 17 of the Environmental Conservation Law and Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York parts 704 and 750 *et seq.* by Entergy Nuclear Indian Point 2, LLC and Entergy Nuclear Indian Point 3, LLC, Permittee,	**DEC # 3-5522-00011/00004** **SPDES # NY-0004472**
-and-	
In the Matter of the Application by Entergy Nuclear Indian Point 2, LLC and Entergy Nuclear Indian Point 3, LLC, and Entergy Nuclear Operations, LLC for a Certificate Pursuant to §401 of the Federal Clean Water Act.	**DEC # 3-5522-00011/00030** **DEC # 3-5522-00011/00031**

REBUTTAL TESTIMONY OF ROBERT M. FAGAN REGARDING REPLACEMENT POWER AIR EMISSIONS AND ELECTRIC SYSTEM RELIABILITY IMPACTS OF CLOSED-CYCLE COOLING, ON BEHALF OF INTERVENORS RIVERKEEPER, INC., SCENIC HUDSON, INC., AND NATURAL RESOURCES DEFENSE COUNCIL, INC.

A. Introduction

Q. Please identify yourself.

A. My name is Robert M. Fagan; I am a Principal Associate at Synapse Energy Economics, a research and consulting firm specializing in energy, economic and environmental issues, located at 485 Massachusetts Ave., Cambridge, MA 02139.

Q. Have you previously provided testimony in these proceedings?

A. Yes. I have provided prefiled direct testimony, dated February 28, 2014, in the above-captioned State Pollutant Discharge Elimination System ("SPDES") proceeding with respect to the potential impacts to electric power sector reliability and electric power sector air emissions associated with the construction and operation of the closed-cycle cooling system configurations proposed by the New York State Department of Environmental Conservation (NYSDEC) and Entergy for the Indian Point nuclear power plant, in order to inform the analysis being conducted

in connection with the above-captioned proceeding by NYSDEC under New York's State Environmental Quality Review Act (SEQRA).

Q. Please describe the purpose of your rebuttal testimony.

A. My testimony herein is offered in rebuttal to (1) portions of the prefiled direct testimony of Entergy witnesses David Harrison and Marc Lawlor and certain supporting exhibits thereto, (2) the prefiled direct testimony of the City of New York witness, Christopher Russo, and supporting exhibits thereto, and (3) an apparent exhibit prepared by the African American Environmentalist Association ("AAEA"), all submitted in this proceeding in relation to, at least in part, the implementation of closed-cycle cooling as BTA at the Indian Point Energy Center ("IPEC"). In addition, my testimony provides my responses and opinions with respect to certain portions of the prefiled direct testimony of NYSDEC witnesses Leka P. Gjonaj & David Wheat, and Thomas S. Paynter. My testimony will specifically address the portions of the above prefiled submissions that relate to the potential impacts to electric power sector reliability and replacement power air emissions associated with the construction and operation of either the NYSDEC-proposed or Entergy-proposed closed-cycle cooling proposals at IPEC.

Q. What have you reviewed and relied upon in preparation of this rebuttal testimony?

A. I have read the prefiled direct testimony of the witnesses referenced above and certain pertinent exhibits and materials on which each such witness relies. In addition to my review of those documents, I have relied upon and considered (1) my education, experience, training, and best professional judgment, (2) the modeling and analysis I conducted in support of my prefiled direct testimony in this matter, (3) the documents that I previously identified in my prefiled direct testimony and/or supporting report (as amended), and (4) certain additional documents, which I have identified and listed in the supplemental bibliography that follows this testimony.

B. Rebuttal to Entergy's Witnesses

Q. Entergy's witness, Dr. Harrison, testifies that his report entitled "Impacts to the New York State Electricity System if Indian Point Energy Center Were Not Available," dated December 2013 (submitted as Entergy Exhibit 296E and referred to as "NERA Impacts Report"), "analyzed the impacts to the electricity system and other related impacts if IPEC were not available to supply electricity. . . ."[1] What is your understanding of the outage circumstances analyzed by Dr. Harrison in this report?

A. The NERA Impact Report analyzed potential reliability and air emissions impacts of one outage scenario, a five-year concurrent outage of both IPEC units (2015-2019) under a single set of load and resource assumptions and with no changes to the 2013 transmission system infrastructure.[2] This scenario was compared to a single scenario with IPEC in-service (Entergy's "base case" scenario).[3]

Q. Is Dr. Harrison's consideration of this outage circumstance helpful to inform the Tribunal's consideration of electricity impacts resulting from the implementation of either NYSDEC or Entergy's closed-cycle cooling proposals?

A. No. Dr. Harrison's NERA Impacts Report does not present specific impact results if IPEC outages occur for periods of less than five full years for closed-cycle cooling tower installation. More importantly, Dr. Harrison's NERA Impacts Report does not consider the effects of the Reliability Contingency Plan (RCP) related to Indian Point,[4] nor does it test replacement power air emissions impacts with reasonable load, transmission and resource options for the range of resource alternatives under consideration in the region. In summary, the

[1] CCC Harrison February 28, 2014 Direct at 19:11-16, 20:1-3.

[2] **Entergy Exhibit 296E**, Impacts Report, Appendix D, at D-13 (using transmission system representation from the 2013 Installed Reserve Margin (IRM) report. That representation excludes any effects from transmission owner transmission solution (TOTS) or alternating current (AC) transmission proceeding reinforcements that would be in place at any point during the 2015-2019 interval modeled).

[3] **Entergy Exhibit 296E**, Impacts Report, Appendix D, at D-1.

[4] *See* State of New York Public Service Commission. *Order Accepting IPEC Reliability Contingency Plans, Establishing Cost Allocation and Recovery, and Denying Request for Rehearing.* Case 12-E-0503, Proceeding on Motion of the Commission to Review Generation Retirement Contingency Plans. November 4, 2013), appended to **Riverkeeper Exhibit 109**, Synapse IPEC Report in Appendix C.

report does not explore any ramifications of increased levels of energy efficiency[5] or renewable resource deployment[6] beyond its base case assumptions, which particularly can affect emissions levels in later years. It also does not consider the effects if the Champlain Hudson Power Express[7] goes online in January 2018, nor does it test the sensitivity of any additional new lower Hudson Valley gas-fired capacity beyond the CPV Valley plant coming online (in January 2018 in NERA's analysis).[8] The report assumes dependence on older Astoria units to make up any shortfalls in capacity need; those resources affect Dr. Harrison's emissions analysis in the NERA Impacts Report, but NERA did not test the effect of any repowering at Astoria to replace older units.[9]

Q. What conclusions does Dr. Harrison reach in his NERA Impacts Report?

A. Dr. Harrison concludes that "substantial adverse near-term impacts" would occur to system reliability and greenhouse gas and local air emissions. He also concludes that substantial adverse near-term effects on wholesale electricity prices will occur.[10]

Q. Dr. Harrison testifies that his Impacts Report used the PROMOD model to conduct his analysis.[11] Do you have any comments regarding Dr. Harrison's reliance on this model for the purposes expressed in his NERA Impacts Report and direct testimony?

[5] **Entergy Exhibit 296E**, Impacts Report, Appendix D, at D-9 to D-10.

[6] **Entergy Exhibit 296E**, Impacts Report, Appendix D, at D-2, Table D-1 (contains wind additions assumed).

[7] NY ISO Interconnection Queue. January 2014 (NY ISO Queue #305, 1000 MW DC interconnection at Astoria 345 kV substation (proposed operation date of December, 2017)).

[8] The NERA Impacts Report assumes Cricket Valley (1,000 MW natural gas combined cycle plant proposed for the LHV) will not be built. **Entergy Exhibit 296E**, Impacts Report, Appendix A at A-3 to A-4.

[9] **Entergy Exhibit 296E**, Impacts Report, Appendix A at A-4. The Impacts Report states that the "Berrians" facility would not be built "based on a rough assessment that it would not likely be economic even if IPEC were not available." Thus, NERA does not test the effect on emissions of any of the NRG repowering proposals at Astoria. Those proposals include 1) 250 MW of combined cycle capacity with proposed operation date of June 2017 (NY ISO Interconnection Queue. January 2014 (NY ISO queue # 201 and 224, part of "Phase I" repowering proposals)), 2) 250 MW of combined cycle capacity with proposed operation date of June 2016 (NY ISO Interconnection Queue. January 2014 (NY ISO queue # 266, also part of "Phase I" repowering proposals)), and 3) 500 MW of combined cycle capacity with proposed operation date of June 2018 (NY ISO Interconnection Queue. January 2014 (NY ISO queue # 393, part of "Phase II" repowering proposals by NRG)).

[10] CCC Harrison February 28, 2014 Direct at 20:12-17.

[11] CCC Harrison February 28, 2014 Direct at 20:1-10.

A. The PROMOD model itself is generally acceptable for use in assessing air emissions impacts, but the results must be interpreted carefully, and, as with any model that assesses hourly electric generation and air emissions, the assumptions used drive the results. As noted above, however, Dr. Harrison's NERA Impacts Report has not used a reasonable set of assumptions in estimating air emissions impacts.

While NERA assumes a level of capacity in its PROMOD modeling to ensure reliability,[12] the NERA Impacts Report nonetheless states that the loss of IPEC "would have significant adverse impacts on reliability"[13]; while also stating that the loss of IPEC "would impair electricity system reliability and would increase the likelihood that the measures listed in Table 1 would need to be taken."[14] In its report, NERA does not explain the difference between its asserted "adverse impacts" and its asserted "impair[ment of] electricity system reliability." NERA provides no metric or analysis in support of its assertion that the loss of IPEC would "increase the likelihood" of using the measures it lists in Table 1, even though it refers to older studies that do include a quantitative estimate of the loss of load expectation (LOLE).[15] PROMOD is not a modeling tool that can be used to estimate loss of load probability, and thus NERA did not use it in that way, and NERA also did not conduct any other form of modeling that could estimate loss of load expectation.

Based on my review of the NERA Impacts Report, Dr. Harrison has used unreasonable assumptions in his air emissions modeling using PROMOD, which renders his analysis unhelpful.

[12] **Entergy Exhibit 296E**, Impacts Report, page 15 ("As a result of these presumed actions and the transmission and increased energy efficiency that will proceed in the baseline as a result of the [Reliability Contingency Plan] RCP (that we assume will be implemented for purposes of this analysis), the potential responses would be sufficient to enable New York to meet reliability requirements if IPEC were not available".)

[13] **Entergy Exhibit 296E**, Impacts Report, S-1.

[14] **Entergy Exhibit 296E**, Impacts Report, p.6. Table 1 of the NERA Impacts Report contains a list of emergency operating procedures used by the NY ISO in the event of a capacity shortage.

[15] **Entergy Exhibit 296E**, Impacts Report, at S-1 to S-2, 12-13.

Q. Do you agree with Dr. Harrison's conclusion that "any unavailability" of IPEC "to supply electricity would result in substantial adverse near-term impacts on . . . system reliability"[16]?

A. No, I do not. The studies referenced and relied upon in the NERA Impacts Report – the 2006 National Research Council study, and the 2012 NY ISO Reliability Needs Assessment (RNA)[17] – are stale and, thus, no longer reflective of what system conditions will be in 2016. The NERA Impacts Report references NY ISO testimony from September 2013 that clearly states that "replacement resources have to be in place prior to a closure of the Indian Point Energy Center. Failure to do so would have serious reliability consequences. . . ."[18] However, the RCP relating to IPEC (and market outcomes, as explained in that Plan) exists to ensure such resources are in place, thus averting the consequences if nothing was being done. Although NERA's report references the IPEC RCP, NERA excludes the resources that will be in place through the plan when considering both reliability and air emissions impacts.

Reliability is dependent on capacity resources and sufficient transmission support to deliver those resources; there will be no shortage of deliverable capacity available in 2016 if both IPEC units were to be out of service for any reason at all. It is only the exact makeup of resources that would be in place that is uncertain now, as reflected in the NYS Public Service Commission (PSC) Order on the IPEC RCP[19] and as summarized in my expert report.[20] Clearly, the NERA Impacts Report fails to consider current information that is critical toward understanding the reliability implications of outages at IPEC.

[16] CCC Harrison February 28, 2014 Direct at 20:12-15.

[17] **Entergy Exhibit 296E**, Impacts Report, pp. 12-13.

[18] **Entergy Exhibit 296E**, Impacts Report, pp. 13-14; **Riverkeeper Exhibit 109**, Synapse IPEC Report at Appendix C (source document from the New York ISO (Testimony of Mr. Thomas Rumsey before the New York State Senate Energy and Telecommunications Committee, September 30, 2013)).

[19] **Riverkeeper Exhibit 109**, Synapse IPEC Report at Appendix C, NYS PSC Order (November 4, 2014), at pages 5-7.

[20] **Riverkeeper Exhibit 109**, Synapse IPEC Report at 44-48.

Based on the foregoing, and my independent analysis as discussed in my previously submitted direct testimony, I do not agree with the conclusion in the NERA Impacts Report that "New York electricity system reliability would be compromised if IPEC were not available."[21]

Q. Do you agree with Dr. Harrison's conclusion that "any unavailability" of IPEC "to supply electricity would result in substantial adverse near-term impacts on . . . system capacity" and "wholesale . . . electricity prices"[22]?

A. No, I do not. While Synapse did not explicitly analyze capacity prices in our report, the assessment in the NERA Impacts Report has a number of flaws in the way in which it constructed its capacity assessment. Also, NERA's flawed assumptions for load, transmission and resource development impact its assessment of, and conclusions in relation to, energy price impacts.

First, NERA's analysis presumes both IPEC units out of service for each of five years, 2015 through 2019.[23] NERA does not analyze capacity impacts, or energy price impacts, or consumer expenditures under IPEC outages of lower duration for closed-cycle cooling installation. Thus, any and all cumulative impacts reported by NERA for these five years exaggerate any effect that would be seen with closed-cycle cooling installation that required IPEC unit outages, the maximum projected outage for which is 42 weeks - less than one year.

Second, NERA increases the capacity requirement for New York City (zone J) by 500 MW based upon its contention that the import capability of the transmission system would be lower absent the IPEC units, because of voltage concerns.[24] NERA references a 2005 NY ISO voltage analysis for the Hudson Valley but fails to cite with any specificity the sections of this report – or any other reference document – that support its conclusion that the transmission transfer

[21] **Entergy Exhibit 296E**, Impacts Report at 32.

[22] CCC Harrison February 28, 2014 Direct at 20:12-15.

[23] For example, **Entergy Exhibit 296E**, Impacts Report at: i) p 23, "Over *the six-year period, increased* expenditures related to capacity price effects would total nearly $7 billion if IPEC were not available"; ii) p. 24, "Over *the six-year period,* increased [electricity] expenditures would total $2 billion if IPEC were not available"; iii) p 25, "The total increase in New York State consumer payments for electricity *from 2015 to 2019* is projected to be almost $9 billion if IPEC were not available." (emphasis added).

[24] **Entergy Exhibit 296E**, Impacts Report at 16.

capability into New York City should be modelled, for capacity pricing purposes, 500 MW lower because of voltage concerns. This assertion is unsupported, and it can have a significant impact on capacity price assessment for New York City: as noted by witness on behalf of NYSDEC, Mr. Paynter, installed capacity (ICAP) prices are "very sensitive to relatively small changes in generation supply," and "the entry of a new 500 megawatt (MW) plant (the size of many fossil-fueled plants) could cause ICAP prices to decrease by about $5 per kilowatt-month (kW-month)...; this could reduce ICAP revenues by half...)."[25] Reducing transmission transfer by 500 MW into New York City is akin to losing 500 MW of capacity in New York, and the sensitivity to which Mr. Paynter refers also applies to a sudden reduction of 500 MW of transfer capability. Thus, this unsupported assertion of NERA's leads to an overestimate of price impacts for New York City capacity.

Third, NERA's assessment of energy price and capacity price impacts does not test for price effects under alternative load, transmission and resource development scenarios. All of these greatly influence electric energy prices, as noted in my expert report, and can also impact capacity prices. Generally, any energy or capacity price increases associated with installation of closed-cycle cooling are short-term, but would also be mitigated by the presence of any increase in transmission resources, energy efficiency, and renewable energy supplies. Overall, NERA's failure to consider differing resource scenarios results in exaggerated conclusions regarding system capacity and wholesale electricity price impacts that could result from an closed-cycle cooling construction outage at IPEC.

Q. Do you agree with Dr. Harrison's conclusion that "any unavailability" of IPEC "to supply electricity would result in substantial adverse near-term impacts on . . . consumer electricity prices" and "New York State electricity expenditures"[26]?

A. No. Because consumer expenditures for electricity impacts are dependent in part on wholesale capacity and energy price impacts, and since the NERA Report has exaggerated wholesale energy and capacity price impacts, its consumer expenditures impacts are also

[25] CCC Paynter February 28, 2014 Direct at 4:22 -5:7.

[26] Harrison February 28, 2014 Direct at 20:12-16.

exaggerated. Also, the NERA report specifically presents a total expenditure impact over a "six year period", assuming an IPEC outage for a full five years.[27] Any five-year total reported by NERA assumes IPEC units would be out of service for five consecutive years for closed-cycle cooling installation; such an outage is not supported by the Tetra Tech or Enercon report sections on length of construction outage, which is limited to less than one year.

Q. Do you agree with Dr. Harrison's conclusion that "any unavailability" of IPEC "to supply electricity would result in substantial adverse near-term impacts on . . . greenhouse gas and local air emissions"[28]?

A. No, I do not agree. Greenhouse gas and local air emissions in New York State will change minimally if IPEC is out of service for cooling tower installation, the maximum outage for which is projected to be 42 weeks. Importantly, factors other than any IPEC outage will also affect the level of emissions that would be seen, and such factors should be considered in any analysis of "near-term" greenhouse gas and local air emissions impacts associated with cooling tower installation at IPEC. These other factors, addressed extensively in my Direct Testimony and my expert report, include transmission upgrades, energy efficiency deployment, and renewable resource (wind and solar photovoltaic (PV)) deployment. Transmission resource deployments are not speculative: the RCP and the AC Transmission Proceeding addressed extensively in my expert report documents the approval of and the planning for these resource deployments. Energy efficiency and renewable development goals aligned with New York State's energy policies are not speculative; while the exact magnitude and installation trajectory over time may vary depending on a number of factors, the levels ultimately deployed are highly likely to be materially greater than the barest minimum used in Dr. Harrison's analysis. Dr. Harrison's analysis does not address the sensitivity of emissions impacts to these factors, and thus his results represent a relatively narrow assessment using one modelled IPEC-outage scenario against a single baseline IPEC-in-service scenario.

Also, Dr. Harrison presents his results as a percentage change from his baseline scenario for each year analyzed.[29] For example, he reports estimated increases in CO_2 emissions on a regional

[27] **Entergy Exhibit 296E**, Impacts Report at 24.

[28] CCC Harrison February 28, 2014 Direct at 20:12-17.

basis for each of the years 2015 through 2019. He reports estimated increases in NO_X emissions for New York State as a whole for the same period. In the case of CO_2, he shows regional CO_2 increases over baseline levels, and also those same increases as a fraction of New York State Regional Greenhouse Gas Initiative (RGGI) goals,[30] but he does not report New York State CO_2 emissions compared to New York State RGGI requirements. His report does not show NO_x emissions impacts by New York State zone. A more complete assessment of greenhouse gas and local air emissions would review the sensitivity of emission changes to other factors, and how such effects change over time relative to initial periods, and not solely view the loss of IPEC's generation in isolation from such other factors and time periods.

Synapse's modeling , on the other hand, did address these sensitivities, and did show how effects change over time. I have developed Tables R1, R2, and R3 below based on the information initially provided in my expert report,[31] to reiterate and more explicitly show CO_2 and NO_x emissions changes on a percentage basis.

The first section (left-hand side) of Table R1 below shows CO_2 emissions (in millions of metric tons) from New York State generation resources for 2015 through 2025 for five of Synapse's modelled scenarios: the base scenario 1, the sequential year-long outage scenarios 31 and 34, and the bookend IPEC fully-out-of-service scenarios 11 and 14. The middle section then shows the percentage change in CO_2 emissions from the base scenario in each of these years. Lastly, the third section (right-hand side) shows the percentage change in CO_2 emissions from the 2015 baseline year for scenario 1.[32] The middle section of Table R1 shows that relative emission changes from a baseline vary depending on both the specific outage assumption, and the assumptions used for other factors – in this case, deployment of energy efficiency, wind and solar PV resource development. As Table R1 illustrates, when considering the effect of the time period of outage (less than five years for cooling tower installation) and/or the effect that

[29] **Entergy Exhibit 296E**, Impacts Report , pp. 27-30.

[30] **Entergy Exhibit 296E**, Impacts Report at Table 13 and Table 14

[31] **Riverkeeper Exhibit 109**, Synapse IPEC Report at Figures 7 and 9.

[32] **Riverkeeper Exhibit 109**, Synapse IPEC Report at Figure 7 (derived from tabular data posted below Figure 7).

additional deployment of energy efficiency and renewable resource deployment has on emissions, the relative change varies considerably.

By way of example, under a 2-sequential-year outage for cooling tower installation as described in our report, the year 2018 would see an increase of 7.9% in CO_2 emissions relative to base scenario 2018 emissions, but when considering the effects of potential energy efficiency and renewable resource development for the same outage scenarios, CO_2 emissions *decline* 8.7%. Furthermore, for the same year (2018), if the CO_2 emissions are compared to CO_2 emissions seen in the base year 2015, emissions increase just 1% for scenario 31 (assuming no changes in energy efficiency or renewable resource deployment), and decline by 15% if such changes are considered. These four values are emphasized in the table. Also, note that scenarios 31 and 34 assume cooling tower installation occurring over two sequential years, 2017-2018, consistent with a potential closed-cycle cooling construction scenario recognized in the Tetra Tech Report. To the extent that cooling tower installation occurs in later years, when transmission, energy efficiency, and renewable resource deployments are likely to be greater than what will be seen in 2017-2018, overall emissions impacts of a construction outage at IPEC will be lower than what would be seen in 2017-2018.

Table R1. Percentage Change in New York State CO2 Emissions from Baseline in Each Year, and from Baseline in 2015, for Four Scenarios of Resource Deployment/Outage Period, 2015-2025.

	CO_2 Emissions, Million Metric Tons, by Scenario					Emission Reduction Relative to Base Scenario 1 for Each Year				Emission Reduction Relative to 2015 Levels for Base Scenario 1				
Synapse Sc. #	S1	S31	S34	S11	S14	S31 minus S1	S34 minus S1	S11 minus S1	S14 minus S1	S1	S31	S34	S11	S14
IPEC status	In-Service	2 Seq. Years OOS	2 Seq. Years OOS	Fully OOS	Fully OOS					In-Service	2 Seq. Years OOS	2 Seq. Years OOS	Fully OOS	Fully OOS
EE, Wind, PV status	Base levels EE, wind, PV	Base levels EE, wind, PV	Hi EE, Hi wind, Hi PV	Base levels EE, wind, PV	Hi EE, Hi wind, Hi PV									
2015	37.4	37.4	34.5	37.4	34.5	0.0%	-7.8%	0.0%	-7.8%	0%	0%	-8%	0%	-8%
2016	38.2	39.0	33.1	43.2	36.8	2.1%	-13.3%	13.2%	-3.6%	2%	4%	-11%	16%	-2%
2017	37.4	40.2	34.2	42.4	36.1	7.5%	-8.6%	13.4%	-3.5%	0%	8%	-8%	14%	-3%
2018	34.8	37.6	31.8	40.1	34.1	**7.9%**	**-8.7%**	15.1%	-2.0%	-7%	**1%**	**-15%**	7%	-9%
2019	34.7	34.9	29.2	40.0	33.6	0.5%	-15.9%	15.2%	-3.1%	-7%	-7%	-22%	7%	-10%
2020	34.9	35.1	29.7	40.0	34.0	0.5%	-15.0%	14.6%	-2.6%	-7%	-6%	-21%	7%	-9%
2021	35.9	36.0	30.6	40.7	34.7	0.5%	-14.7%	13.6%	-3.2%	-4%	-4%	-18%	9%	-7%
2022	35.7	35.9	30.3	40.6	34.4	0.5%	-15.2%	13.7%	-3.6%	-4%	-4%	-19%	9%	-8%
2023	35.9	36.1	30.1	40.8	34.1	0.5%	-16.2%	13.6%	-5.0%	-4%	-3%	-20%	9%	-9%
2024	36.1	36.3	29.9	41.0	33.9	0.4%	-17.3%	13.4%	-6.2%	-3%	-3%	-20%	10%	-9%
2025	36.5	36.7	30.2	41.2	34.1	0.5%	-17.4%	12.8%	-6.6%	-2%	-2%	-19%	10%	-9%

Source: Synapse PROSYM modeling, scenarios 1, 11, 14, 31, 34; **Riverkeeper Exhibit 109**, Synapse IPEC Report, data from Figure 7.

Table R2 below shows similar findings for NO_x emission effects in New York under different IPEC outage scenarios and for different resource deployment assumptions.

The first section (left-hand side) of Table R2 shows NO_x emissions (in thousands of metric tons) from New York State generation resources for 2015 through 2025 for five of Synapse's modelled scenarios: the base scenario 1, the sequential year-long outage scenarios 31 and 34, and the bookend IPEC fully-out-of-service scenarios 11 and 14. The middle section then shows the percentage change in NO_x emissions from the base scenario in each of these years. Lastly, the third section (right-hand side) shows the percentage change in NO_x emissions from the 2015 baseline year for scenario 1.[33] The middle section of Table R2 shows that, as with CO_2, relative emission changes for NO_x (from a baseline) vary depending on both the specific outage assumption, and the assumptions used for other factors – in this case, deployment of energy efficiency, wind and solar PV resource development. As seen, when considering the effect of the time period of a relatively short construction outage for closed-cycle cooling construction (i.e., a fraction of the five year scenario considered in the NERA Impact Report) and/or the effect that additional deployment of energy efficiency and renewable resource deployment has on emissions, the relative change varies considerably.

For example, under a 2-sequential one-year outages scenario for cooling tower installation as described in our report, the year 2018 would see an increase of 8.1% in NO_x emissions relative to base scenario 2018 emissions, but when considering the effects of potential energy efficiency and renewable resource development for the same outage scenarios, NO_x emissions *decline* 22.4%. Furthermore, for the same year (2018), if the NO_x emissions are compared to NO_x emission seen in the base year 2015, emissions *decrease* 17% for scenario 31 (assuming no changes in energy efficiency or renewable resource deployment), and *decline* by 41% if such changes are considered.

[33] **Riverkeeper Exhibit 109**, Synapse IPEC Report at Figure 9 (derived from tabular data posted below Figure 9).

Table R2. Percentage Change in New York State NOX Emissions from Baseline in Each Year, and from Baseline in 2015, for Four Scenarios of Resource Deployment/Outage Period, 2015-2025.

	NYS NOx Emissions, Thousand Metric Tons, by Scenario					Emission Reduction Relative to Base Scenario 1 for Each Year				Emission Reduction Relative to 2015 Levels for Base Scenario 1				
Synapse Sc. #	S1	S31	S34	S11	S14	S31 minus S1	S34 minus S1	S11 minus S1	S14 minus S1	S1	S31	S34	S11	S14
IPEC status	In-Service	2 Seq. Years	2 Seq. Years	Fully OOS	Fully OOS					In-Service	2 Seq. Years OOS	2 Seq. Years OOS	Fully OOS	Fully OOS
EE, Wind, PV status	Base levels EE, wind, PV	Base levels EE, wind, PV	Hi EE, Hi wind, Hi PV	Base levels EE, wind, PV	Hi EE, Hi wind, Hi PV									
2015	18.7	18.7	17.0	18.7	17.0	0.0%	-8.8%	0.0%	-8.8%	0%	0%	-9%	0%	-9%
2016	18.1	18.9	13.2	21.2	14.7	4.4%	-26.8%	17.6%	-18.6%	-3%	1%	-29%	14%	-21%
2017	17.0	18.4	12.9	19.8	13.5	8.2%	-24.3%	16.1%	-20.6%	-9%	-2%	-31%	6%	-28%
2018	14.3	15.4	11.1	16.3	11.7	8.1%	-22.4%	14.4%	-18.3%	-24%	-17%	-41%	-13%	-38%
2019	14.5	14.5	10.6	16.5	11.6	0.1%	-26.7%	13.6%	-20.0%	-22%	-22%	-43%	-12%	-38%
2020	13.4	13.4	10.4	15.2	11.3	-0.1%	-22.1%	13.4%	-15.7%	-28%	-28%	-44%	-19%	-40%
2021	12.9	12.9	10.1	14.4	10.9	0.1%	-21.4%	12.1%	-15.7%	-31%	-31%	-46%	-23%	-42%
2022	12.3	12.3	10.0	13.8	10.7	0.1%	-18.9%	12.7%	-13.1%	-34%	-34%	-47%	-26%	-43%
2023	12.4	12.4	10.0	14.1	10.6	0.1%	-19.7%	13.2%	-14.8%	-33%	-33%	-47%	-25%	-43%
2024	12.4	12.5	9.7	14.1	10.3	0.3%	-21.7%	13.0%	-16.9%	-33%	-33%	-48%	-25%	-45%
2025	12.0	12.0	9.5	13.3	10.0	0.1%	-21.1%	11.3%	-16.2%	-36%	-36%	-49%	-29%	-46%

Source: Synapse PROSYM modeling, scenarios 1, 11, 14, 31, 34 (**Riverkeeper Exhibit 109**, Synapse IPEC Report, data from Figure 9)

Similar patterns are seen for New York City NO_x emissions. Table R3 below presents the changes in NO_x emissions in Zone J for the four scenarios, from 2015 to 2025. For the sequential year-long outage scenarios (scenarios 31 and 34), New York City NO_x emissions relative to 2015 electric power sector emissions would be 12% higher in 2016 *if* no assumptions about increased energy efficiency or renewables were considered, yet still drop to 2% *below* 2015 emissions by 2017 in this scenario. For the scenario with increased levels of energy efficiency and renewable development, *absolute declines* in NO_x emissions in the City are seen for all years for the sequential year-long outage scenario (scenario 34).

Relative (to base scenario 1) increases in modelled NYC NO_x emissions for the sequential year-long outage scenarios (scenarios 31 and 34) are seen in the middle section of Table R3 only for the early years (2016 and 2017, for scenario 34; and 2016-2018 for scenario 31). These percentage increases must be considered in the context of the 2015 emissions levels. As noted, the only absolute increase in NO_x emissions for the sequential year-long outage scenarios is seen in 2016 (12%) and only if one unrealistically assumes no additional deployment of energy efficiency or renewable energy beyond baseline amounts by that year. Even in that scenario, by 2017 NO_x levels are again below those seen in 2015.

Table R3. Percentage Change in New York City (Zone J) NO_x Emissions from Baseline in Each Year, and from Baseline in 2015, for Four Scenarios of Resource Deployment/Outage Period, 2015-2025.

	NYC NOx Emissions, Thousand Metric Tons, by Scenario					Emission Reduction Relative to Base Scenario 1 for Each Year				Emission Reduction Relative to 2015 Levels for Base Scenario 1				
Synapse Sc. #	S1	S31	S34	S11	S14	S31 minus S1	S34 minus S1	S11 minus S1	S14 minus S1	S1	S31	S34	S11	S14
IPEC status	In-Service	2 Seq. Years OOS	2 Seq. Years OOS	Fully OOS	Fully OOS					In-Service	2 Seq. Years OOS	2 Seq. Years OOS	Fully OOS	Fully OOS
EE, Wind, PV status	Base levels EE, wind, PV	Base levels EE, wind, PV	Hi EE, Hi wind, Hi PV	Base levels EE, wind, PV	Hi EE, Hi wind, Hi PV									
2015	2.6	2.6	2.1	2.6	2.1	0.0%	-20.6%	0.0%	-20.6%	0%	0%	-21%	0%	-21%
2016	2.4	2.9	2.5	3.6	3.1	20.8%	3.8%	48.3%	28.3%	-7%	12%	-4%	37%	19%
2017	2.0	2.5	2.2	2.9	2.5	24.0%	7.1%	43.1%	20.4%	-21%	-2%	-16%	13%	-5%
2018	1.4	1.6	1.3	1.9	1.6	14.7%	-6.4%	30.8%	14.1%	-45%	-37%	-49%	-29%	-38%
2019	1.4	1.4	1.2	1.8	1.5	0.0%	-16.6%	28.0%	7.0%	-45%	-45%	-54%	-30%	-41%
2020	1.4	1.4	1.2	1.8	1.4	0.0%	-19.1%	24.8%	1.3%	-45%	-45%	-56%	-31%	-44%
2021	1.3	1.3	1.1	1.6	1.3	0.0%	-16.4%	24.0%	1.4%	-49%	-49%	-57%	-37%	-48%
2022	1.3	1.3	1.1	1.6	1.3	0.0%	-17.6%	21.6%	0.0%	-48%	-48%	-57%	-37%	-48%
2023	1.4	1.4	1.1	1.6	1.3	0.0%	-18.0%	18.7%	-2.7%	-48%	-48%	-57%	-38%	-49%
2024	1.3	1.4	1.1	1.6	1.3	1.4%	-20.9%	18.9%	-6.8%	-48%	-48%	-59%	-38%	-52%
2025	1.3	1.3	1.1	1.5	1.2	0.0%	-15.2%	21.7%	-2.9%	-52%	-52%	-59%	-41%	-53%

Source: Synapse PROSYM modeling, scenarios 1, 11, 14, 31, 34; zonal data for New York City (*see* Appendix A herein).

Q. Please contrast Dr. Harrison's conclusions on air emissions with the analysis shown in the three tables above.

A. The above Tables and analysis, drawn from the modeling results presented in my expert report, illustrate that the conclusions drawn by Dr. Harrison in the NERA Impacts Report about CO_2 and NO_x emissions impact are not broadly applicable to the circumstances surrounding closed-cycle cooling installation at Indian Point. This is because Dr. Harrison i) does not appropriately account for all the factors that drive emissions impact, and ii) does not analyze the effects under IPEC outage durations shorter than five years. Both the Tetra Tech and the Enercon reports indicate outage requirements at IPEC for cooling tower installation for less than one year, let alone five years as considered in the NERA Impacts Report. NERA's analysis fully excludes the effect on emissions that would be seen under scenarios where any combination of deployment of the following resources or system improvements occurs: Champlain Hudson Power Express, NRG Astoria repowering, additional lower Hudson Valley gas-fired generation (modelled by Synapse as the deployment of Cricket Valley), increased energy efficiency, increased deployment of upstate wind and state-wide solar PV, and increased transmission that allows increases in upstate to downstate energy transfer.

Q. Do you agree with Dr. Harrison's conclusion that "any unavailability" of IPEC "to supply electricity would result in substantial adverse near-term impacts on . . . fuel diversity."[34]

A. No, I do not. The NERA Impact Report does not assess the contributions of incremental amounts of energy efficiency, wind power, solar PV, or Canadian Hydro (in the form of the proposed Champlain Hudson Power Express), which are reasonable resource scenarios to consider even without the loss of IPEC for cooling tower installation. Thus, any conclusions drawn are not based on an assessment of all possible sources of electric power sector fuel diversity under IPEC outages for closed-cycle cooling installation.

[34] CCC Harrison February 28, 2014 Direct at 20:12-17.

Q. Are the assumptions used in the NERA Impacts Report consistent with New York State policies for electricity resources, including the New York State Energy Plan?

A. The NERA Impacts Report exhibits inconsistency with New York State policies, including those set forth in the New York State Energy Plan, relating to transmission, energy efficiency and renewable resource goals in a number of critical areas, especially in regards to NERA's emissions effects assessment. The NERA analysis explicitly did not assume or test for the effect of the installation of additional transmission assets to increase transfers between upstate and downstate New York. NERA did not assess the effect of increases in renewable energy deployment beyond minimal levels of increased wind power. NERA did not test for the effects of increased energy efficiency levels beyond baseline amounts from the 2013 Gold Book. The NERA analysis fails to account for any increases in the installations of solar PV, even though the New York State Energy Research and Development Authority (NYSERDA) has petitioned for funding for a significant level of increase in installed solar PV. NERA did not include the effect of key proposed downstate resource deployments, such as the Champlain Hudson Power Express or the repowering of some of the older Astoria generation assets held by NRG.

Q. Please summarize your conclusions regarding Dr. Harrison's NERA Impacts Report.

A. Dr. Harrison's NERA Impacts Report fails to substantiate concerns that the loss of IPEC for the construction of closed-cycle cooling, or the operation of IPEC with closed-cycle cooling,[35] would lead to adverse reliability impacts. The NERA Impacts Report notes the presence of the RCP and includes resources presuming that that plan will be effective, but nonetheless relies on outdated reports to suggest that reliability will be threatened in the event of an IPEC outage for any reason in 2016. Current information on efforts underway by the NYS DPS indicates that reliability will not be a concern if the IPEC units are out of service in 2016. The NERA Report in significant part is characterized by the conspicuous absence of any consideration of presumptively effective resources which have been identified for and allocated

[35] As discussed in my direct testimony, generation output reduction associated with the operation of IPEC with closed-cycle cooling (i.e., thermal efficiency and parasitic loss effects) were deemed negligible for the purposes of assessing reliability in New York State.

to the contingency of IPEC ceasing operations, as described in the November 4, 2013 NYS DPS Order in the Contingency Plan case.

The NERA Impacts Report also fails to show that IPEC outages would lead to adverse air emissions impacts. NERA did not assess air emissions effects under a reasonable array of potential energy efficiency and renewable resource deployments. NERA did not consider incremental transmission reinforcements planned for New York State in its modeling analysis, and did not include the effect of proposed downstate resources that would have significant impacts on air emissions in the event of an IPEC outage for cooling tower installation.

NERA has produced an analysis that lacks inclusion of foundational assumptions, and thus its conclusions are inaccurate; it does not usefully inform the question of whether there will be reliability and/or air emissions impacts as a result of retrofitting IPEC with closed-cycle cooling.

Q. Entergy's witness, Mr. Lawlor, testifies that the TRC Response Document concluded the construction of closed-cycle cooling at Indian Point "would cause MODERATE to LARGE potential adverse impacts" to electricity "based on the need to replace power losses during construction outages."[36] Do you agree with this conclusion?

A. No. Riverkeeper's counsel has advised me that the appropriate framework for the impacts associated with cooling tower construction outages is New York SEQRA, not the National Environmental Policy Act (NEPA) categories used by Mr. Lawlor to characterize impacts. In any event, any impacts associated with IPEC outages for cooling tower installation are minimal, especially considering the effects of reinforced transmission infrastructure and the potential deployment of additional energy efficiency and renewable resources. The loss of IPEC energy output during the construction of closed-cycle cooling would be replaced with various sources, as noted in my Direct Testimony and accompanying report. The air emissions impacts of that loss would vary, depending on a number of different scenarios that might arise under the

[36] CCC Lawlor February 28, 2014 Direct at 15:14-20; *id.* at 13:7, 14:3-5.

cooling tower construction outage, also as noted in my Direct Testimony[37] and accompanying report.[38]

Q. Entergy's witness, Mr. Lawlor, testifies that the TRC Response Document concluded the operation of closed-cycle cooling at Indian Point would result in "SMALL" impacts to electricity.[39] Do you agree with this conclusion?

A. I do not agree with that characterization, as Riverkeeper's counsel has advised me that the appropriate framework for the impact associated with the operation of cooling towers the is New York SEQRA, not the NEPA categories used by Mr. Lawlor to characterize impacts. In any event, the effect of the operation of closed-cycle cooling at IPEC would be *de minimis* to the electricity sector in New York state because the magnitude of operating effect (due to parasitic losses and thermal efficiency degradation) is but a tiny fraction of peak demand and energy consumption in New York State.

Q. Entergy's witness, Mr. Lawlor, testifies that the TRC Response Document identifies "electricity impacts" as having the potential to be significantly adverse on the environment.[40] Do you agree with this conclusion?

A. No I do not. As noted above and in my Direct Testimony and accompanying expert report, electricity sector impacts (system reliability and replacement power emissions) associated with closed-cycle cooling construction would be minimal. As I have already discussed in detail, electric power sector reliability impacts would be mitigated in the near term by existing system capacity reserves and transmission capabilities and in the long-term by the generation, transmission and conservation projects which are detailed in my report. Electric sector power emissions impacts are, as my report also details, projected to decrease overall with or without IPEC in service.

[37] CCC Fagan February 28, 2014 Direct.

[38] **Riverkeeper Exhibit 109**, Synapse IPEC Report.

[39] CCC Lawlor February 28, 2014 Direct at 15:14-20; *id.* at 13:7, 14:3-5.

[40] CCC Lawlor February 28, 2014 at 12:15-13:7.

Q. Has your review of the testimony of Dr. Harrison and Mr. Lawlor and supporting exhibits thereto, in any way changed your opinions regarding electric reliability and electric power sector air emissions associated with the construction and operation of the closed-cycle cooling system configurations proposed by either NYSDEC or Entergy, as the "best technology available" (BTA) at IPEC?

A. No, my opinion remains the same as expressed in my Direct Testimony and associated report (**Riverkeeper Exhibit 109**, Synapse IPEC Report). Closed-cycle cooling could be constructed at IPEC without significant impacts to electric system reliability or electric power sector air emissions.

C. Rebuttal to NYC Witness Christopher Russo

Q. The witness of the City of New York, Christopher Russo, testifies that he previously conducted a "Retirement Report" that "evaluated and discussed the potential impacts associated with the retirement of IPEC."[41] Do you have summary comments on the efficacy of Mr. Russo's testimony and report?

A. Yes. I have comments on four aspects of Mr. Russo's testimony and the associated 2011 Retirement Report conducted by Charles River Associates (CRA). First, Mr. Russo's analysis does not directly address the impacts of an IPEC outage for closed-cycle cooling installation, but rather is based on the premise that IPEC retires.[42] This disconnect between CRA's modelled duration of IPEC outages, and requirements for IPEC outages for cooling tower installation, leads to inaccurate estimates of reported air emissions effects for any IPEC cooling tower construction outages. Second, Mr. Russo's assessment of reliability impacts is premised primarily on baseline assumptions from the now-stale 2010 NY ISO RNA and ignores in the resource adequacy modeling the presence of the NYS DPS RCP infrastructure improvements. In short, the testimony and report's conclusion that an IPEC outage would lead to adverse near-term

[41] CCC Russo February 28, 2014 Direct at 4:17-20.

[42] As I have previously indicated, counsel for Riverkeeper has informed Synapse that Riverkeeper's position is that the shutdown of Indian Point is not properly relevant to a SEQRA review in connection with NYSDEC's April 2, 2010 Denial of Entergy's requested Clean Water Act Section 401 water quality certification. Any discussion of permanent shutdown of Indian Point herein is without prejudice to Riverkeeper's position.

reliability impacts is flawed because underlying assumptions are outdated. Third, Mr. Russo's baseline assumptions and the sensitivity cases used to assess air emissions impacts have critical limitations. In particular, CRA's analysis used a somewhat limited array of supply and demand-side resource development scenarios, yet its conclusions are couched in language that appears to suggest the completion of a more robust scenario analysis than was actually performed. Fourth, the foundations for Mr. Russo's economic assessment of capacity and energy price effects are flawed.

Q. Mr. Russo testifies that although he did not update the analyses underlying the "Retirement Report," its "conclusions remain broadly applicable" and it is relevant to the instant proceedings relating to the implementation of closed-cycle cooling as BTA at Indian Point.[43] Do you have a response to this?

A. Yes. In short, CRA's 2011 Retirement Report is not "broadly applicable" because the underlying analyses that support its conclusions use stale and/or limiting assumptions. The analyses in the Retirement Report do not incorporate the impacts of approved transmission and demand-side infrastructure improvements associated with the Indian Point RCP,[44] and they fail to update load forecast and resource data to reflect current conditions. The assumptions used in Mr. Russo's scenarios are limited in that they do not fully reflect reasonable combinations of resource alternatives. Lastly, the Retirement Report does not directly examine the reliability, emissions, or economic effects of shorter-term outage durations at IPEC, but instead are fully premised on IPEC retirement.

Q. Mr. Russo testifies that "the retirement or extended outage of both IPEC reactors would" result in "direct and indirect adverse effects on reliability."[45] Do you agree with Mr. Russo's assessment and conclusions regarding the reliability impacts of outages at IPEC?

[43] *See* CCC Russo February 28, 2014 Direct at 7:15-10:19.

[44] The TOTS projects and the Con Edison demand-side initiatives were approved by the NYS DPS in the November 4, 2013 Order in Case 12-E-0503. *See* **Riverkeeper Exhibit 109**, Synapse IPEC Report at Appendix C.

[45] CCC Russo February 28, 2014 Direct at 11:13-15.

A. No. Firstly, the Retirement Report analysis on which Mr. Russo relies for this part of his testimony uses the GE MARS model. The GE MARS model assumptions exclude any direct effects of infrastructure improvements associated with the Indian Point RCP. Those effects include, for example, reduced peak demand in New York City, and improved utilization of capacity resources because of transmission improvements associated with both the lower Hudson Valley area transmission improvements[46] and the effects of "unbottling" generation through improvements in transmission cables across New York City.[47] The RCP estimated that transmission owner transmission solution (TOTS) effects alone would reduce the summer 2016 peak period deficiency associated with an IPEC outage by 600 MW. The GE MARS analysis does not include this effect.

Next, the CRA Retirement Report analysis relies on the 2011 Gold Book Forecast for New York City peak demands. However, the information in the 2011 Gold Book is superseded by 2013 Gold Book assumptions. Although Mr. Russo testifies that there are small differences between energy (GWh) projections between the 2011 Gold Book and the most recent, 2013 Gold Book,[48] he does not address peak demand differences. These differences can greatly impact the relevant analyses; his continued reliance on older peak demand forecast information renders his conclusions inaccurate. For example, Table 14 of the Mr. Russo's Retirement Report lists the NYC non-coincident peak demand used in CRA's modeling as 12,299 MW in 2016, 12,473 MW in 2017, and 12,663 MW in 2018. The 2013 Gold Book forecast of non-coincident peak demands for New York City is 12,006 MW (2016), 12,137 MW (2017), and 12,266 MW (2018) – roughly 300 MW lower in 2016 and 400 MW lower by 2018 than was modelled by CRA in the Retirement Report. The difference in forecast peak demand in New York City by 2020 reaches 474 MW (13,046 minus 12,572). This magnitude of peak demand forecast reduction matters greatly when computing loss of load expectation, as is done with the GE MARS model, but Mr.

[46] TOTS projects underway include the 2nd Ramapo to Rock Tavern 345 kV line and the Marcy South Series Compensation / Fraser – Coopers Corner re-conductoring projects. *See* **Riverkeeper Exhibit 109**, Synapse IPEC Report at 26-27.

[47] For example, the TOTS project Staten Island Unbottling will improve transmission in NYC. *See* **Riverkeeper Exhibit 109**, Synapse IPEC Report at page 45, Table 16; and associated IPEC Contingency Plan filings by ConEd/NYPA in Case 12-E-0503 before the NYPSC, as included in Appendix C of **Riverkeeper Exhibit 109**, Synapse IPEC Report.

[48] CCC Russo February 28, 2014 Direct at 8.

Russo does not address this salient fact when explaining whether or not an update to the Retirement Report has any relevance to his conclusions concerning reliability impacts. He discusses differences in baseline energy (GWh) demand state-wide,[49] but makes no direct reference to peak demand forecast differences in New York City as between that used in the 2011 Retirement Report and forecasts from the more recent 2013 Gold Book.

Exclusion of the RCP effects and use of 2011 Gold Book based peak demand forecasts leads me to conclude that Mr. Russo's reliability assertions – i.e., that the retirement of IPEC will cause adverse reliability effects – are unsupported.

Furthermore, based on my expert review of this issue, and as discussed in my direct testimony, and expert report, I otherwise do not agree with Mr. Russo's conclusions about reliability. As my report shows, there would be no reliability concerns should IPEC go offline for any reason starting in 2016.

Q. Mr. Russo testifies that "the retirement or extended outage of both IPEC reactors would immediately precipitate the need for replacement options and impose direct and indirect adverse effects on reliability that warrant careful consideration."[50] Do you have any comments on this?

A. Yes. The Indian Point RCP has, in fact, very carefully considered the need for replacement options and the purported effects that Mr. Russo is concerned about. The RCP approved transmission and demand-side improvements that partially mitigate those effects, and noted the availability of market resources – both existing and new – to fully mitigate those effects.[51] While Mr. Russo raises the point about the importance of considering the effect of an IPEC outage on reliability, his analysis from which he draws conclusions about reliability excludes the effect of the RCP infrastructure. Precisely as a result of what has already been determined and ordered in the RCP proceeding, there will not be the adverse effects on reliability

[49] CCC Russo February 28, 2014 Direct at 8:10-22.

[50] CCC Russo February 28, 2014 Direct at 11:13-16.

[51] *See* **Riverkeeper Exhibit 109**, Synapse IPEC Report at Appendix C (appending State of New York Public Service Commission. *Order Accepting IPEC Reliability Contingency Plans, Establishing Cost Allocation and Recovery, and Denying Request for Rehearing.* Case 12-E-0503, Proceeding on Motion of the Commission to Review Generation Retirement Contingency Plans. November 4, 2013).

that Mr. Russo has identified, in the event that IPEC shuts down in 2016. Mr. Russo's disregard for information that clearly impacts his 2011 analysis undermines his conclusions about reliability.

Q. Mr. Russo testifies that "the extent to which energy efficiency reliably can offset a loss of IPEC capacity is uncertain."[52] Do you have any comments on this?

A. All factors affecting air emissions, reliability, and economic impacts of an IPEC outage for cooling tower construction are uncertain. But energy efficiency can most certainly reliably offset a portion of IPEC capacity loss and energy loss; and energy efficiency's contribution, even if not replacing 100% of the loss of IPEC, is significant. The level of replacement power from energy efficiency resources will depend upon the outcomes of New York State energy efficiency policy implementation, as most recently confirmed in the New York State DPS Order on Energy Efficiency Portfolio Standards.[53] Mr. Russo's analysis limits the potential for energy efficiency to offset a portion of the IPEC output that would be lost during cooling tower installation by using a projection for total energy demand that is even greater than the baseline energy amounts from the 2013 Gold Book projection. For example, Table 15 of CRA's Retirement Report lists annual energy demand (in terms of GWh) of 170,672 for 2016, and 175,614 for 2020. The 2013 Gold Book lists projected New York State energy demand (in terms of GWh) of 166,804 (2016) and 169,499 (2020). Limiting the analysis to include only a portion of potential energy efficiency leads to an overestimation of the air emissions and economic impacts that would be seen under any policy where energy efficiency levels exceed those forecasted by the NY ISO as part of the 2011 Gold Book forecast.

Q. Do you agree with Mr. Russo that all replacement power would need to be sourced from natural-gas fired supply sources?[54]

[52] CCC Russo February 28, 2014 Direct at 19:12-13.

[53] State of New York Public Service Commission. *Order Approving EEPS Program Changes, Case 07-M-0548,* Proceeding on Motion of the Commission Regarding an Energy Efficiency Portfolio Standard. Issued and Effective December 26, 2013.

[54] CCC Russo February 28, 2014 Direct 20:19-22.

A. No. While natural-gas fired resources are the marginal fuel in New York most often for the purposes of real-time dispatch of the power market, over both near-term and long-term time frames, energy efficiency, renewable resources, and imported power can replace power lost from IPEC during an outage for closed-cycle cooling installation. Mr. Russo ignores longer-term marginal impacts, including market and regulatory response to events such as an IPEC outage for cooling tower installation, and thus oversimplifies the issue by assuming gas-fired generation always represents the replacement power source. The magnitude of replacement power from different sources will depend on the time frame of closed-cycle cooling installation and the sources for replacement power will be a mix of imports, gas-fired resources, renewable resources, and energy efficiency. This is reflected and seen in Synapse's report in Tables 1 and 2.[55]

Q. Mr. Russo testifies that if were to fully IPEC retire, emissions of carbon dioxide, nitrogen oxides and sulphur dioxide would increase.[56] Do you agree with Mr. Russo's assessment and conclusions regarding the air emissions impacts of outages at IPEC?

A. No. Mr. Russo reports average emissions increases based on the underlying CRA 2011 Retirement Report analysis, which presumes IPEC out of service for all years of his analysis. Even if the underlying modeling assumptions were valid, the reported average emission effect does not represent an emission effect under short-term outage conditions that would be associated with closed-cycle cooling installation. That is, Mr. Russo did not analyze the effects of an IPEC outage during a closed-cycle cooling installation.

In any event, the underlying assumptions used in Mr. Russo's estimates of emissions increases in all scenarios exclude the effects of any of the Indian Point RCP improvements that will be in place by the summer of 2016. For future years (from 2018 forward, when additional transmission improvements are expected to be in service), all scenarios exclude any effects from increases in upstate-to-downstate transmission reinforcement. Mr. Russo's analysis does not test the effect of increases in energy efficiency deployment beyond baseline levels, and does not

[55] **Riverkeeper Exhibit 109,** Synapse IPEC Report at Tables 1 and 2.

[56] CCC Russo February 28, 2014 Direct at 23:15-27:3.

explicitly consider the energy efficiency and demand-side improvements approved in the RCP. These facts alone render the emissions aspects of the 2011 Retirement Report analysis stale and overstated, even if full IPEC retirement were the subject of this inquiry.

Importantly, three of Mr. Russo's four scenarios exclude the effects that would be seen if the Champlain Hudson Power Express was placed in service. The beneficial impact on New York City emissions with this resource in place is significant, since that project would displace in-City fossil fuel sources and thus reduce in-City electric generation air emissions. In the one scenario that did test this resource effect, Mr. Russo excludes the effects of any other combined-cycle gas-fired resource deployment. And while Mr. Russo did test a few combinations of new gas-fired combined cycle resource deployment in New York City and the lower Hudson Valley, these scenarios exclude Champlain Hudson Power Express, energy efficiency increases, and RCP transmission improvements.

Mr. Russo presents the 2011 Retirement Report results as representing "a range of potential impacts across the spectrum of likely outcomes"[57] but all of his likely outcomes exclude the presence of either approved or planned resources, and I conclude that the shortcomings seen in his analysis undermine the robustness implied by Mr Russo's testimony relating to air emissions increases.

Q. Mr. Russo testifies about specific results from the 2011 CRA Retirement Report on purported NO_X and CO_2 emission increases.[58] Do you have any comments on this?

A. Mr. Russo's findings on the magnitude of emissions increase are based on comparison to baseline emissions in the same year but with IPEC out of service. The values do not reflect any indication of the absolute level of emissions over time under any scenario with IPEC out of service. As I indicated in Tables R1, R2 and R3 above, adherence to a framework that only compares emissions in any given year to a "baseline" scenario for that same year fails to

[57] CCC Russo February 28, 2014 Direct 7:13-14.

[58] CCC Russo February 28, 2014 Direct at 24.

recognize ongoing downward emission effects over time due to all the factors that influence air emissions.

Q. Do you have any comment on Mr. Russo's assumptions or results as they pertain to the economic impact of an IPEC outage for closed-cycle cooling installation?

A. Yes. The basis for Mr. Russo's testimony and report is a retirement of both IPEC units. Under outages for cooling tower installation, the duration of IPEC energy and capacity loss will be different than what Mr. Russo modelled. While there may be some merit in analyzing any one year that includes effects of IPEC out of service for that year, Mr. Russo's analysis in general did not look at briefer outage periods that are predicted based on the Tetra Tech or Enercon reports, which presume a range of 30 to 42 weeks of outages at IPEC to connect cooling tower infrastructure.

Also, all of Mr. Russo's economic effect calculations ignore the effects of new transmission infrastructure, especially infrastructure which would allow increases in upstate capacity and energy resources to provide for downstate capacity and energy needs. This omission upsets the balance of all Mr. Russo's computations, in particular for the out years of his analysis. Also, failing to model the potential for greater increases in wind and solar PV installation in New York means that under any scenarios of more aggressive renewable resource development, Mr. Russo's calculations will be in error. Lastly, the impact of increased levels of energy efficiency, combined with a reinforced transmission system can materially change the results of both capacity and energy market price analyses – all else equal, both resource improvements tend to lower energy and capacity prices. Mr. Russo's analysis is not robust enough to take these factors into account.

Q. Based upon your review of the testimony of Mr. Russo and supporting exhibits thereto, submitted by the City of New York in this proceeding, have you changed your opinions regarding reliability and electric power sector air emissions associated with the construction and operation of the closed-cycle cooling system configurations proposed by either NYSDEC or Entergy for IPEC?

A. No. Either NYSDEC or Entergy's closed-cycle cooling proposals could be installed without threatening New York State reliability and without significant impacts to air emissions in New York State.

D. Rebuttal to Exhibit of AAEA

Q. As you are aware, intervenor in this proceeding AAEA has generated a "report" entitled, "Fish Eggs Versus Asthmatic Children in Harlem" (hereinafter referred to as "the AAEA Report"). Do you have any comments regarding the scope of this report?

A. Yes. I understand AAEA's report to purportedly address air quality impacts and replacement power issues associated with Entergy deciding not to implement closed-cycle cooling at IPEC and instead deciding to shut down permanently. While the scope of AAEA's report is not actually germane to a consideration of impacts associated with the implementation of closed-cycle cooling at IPEC, I have several comments that respond to certain positions taken by AAEA relating to air emissions impacts in New York State in the event of IPEC outages, as I explain below.

Q. What would be the impact to the New York City region's NO_x air emissions[59] under the different replacement power scenarios you analyzed in the event of an outage of IPEC for cooling tower construction?

A. Table R3 above summarizes the NO_x emission impacts for the New York City zone. In all scenarios, NO_x emissions are lower than 2015 levels from the year 2018 and beyond, reflecting the effects of new resources and transmission in reducing New York City electric power sector emissions in any IPEC outage scenario. Two scenarios, scenario 31 and scenario 34, show the range of impact across time (2016-2025) for the New York City zone under a specified two-sequential-years outage of IPEC Units 2 and 3 using the assumptions described in my expert report. In scenario 34, NO_x emissions are always (in all years) lower than 2015

[59] NO_x emissions are the local (New York City) pollutant of interest concerning replacement power sources. SO_2 emissions are minimal in New York City because most plants are dual-fueled or natural gas fueled, and oil is generally uneconomic compared to natural gas. Natural gas-fueled plants do not emit SO_2. CO_2 emissions are of concern statewide. Thus, I focus on NO_X when considering the type of impacts asserted by AAEA.

emissions. In scenario 31, (which conservatively assumes *no* increases in energy efficiency or renewables above base levels) NO_x emissions are higher than 2015 levels only in one year, 2016, by 12%. The two bookend scenarios show what the impacts would be in any given year if both IPEC units were concurrently out of service for cooling tower installation, and only for one or two years do NO_x emissions rise above 2015 levels, and only minimally (19%, for one year, 2016) if increased levels of energy efficiency and renewable deployments are considered.

Q. Can you identify any specific modeling support for the generic assertions regarding air emissions impacts provided in the AAEA Report?

A. No.

Q. Does the AAEA Report present evidence regarding specific power plants that would be expected to provide replacement energy in the event of outages at IPEC, and which would result in disproportionate air quality impacts on specific environmental justice communities?

A. No. The report generally asserts that replacement power will come from power plants located in environmental justice communities, but it does not demonstrate any particular power plant generation (or emissions) increases, nor does it seem to account for any of the factors that drive replacement power sources, as noted in my expert report and Direct Testimony.

Q. The AAEA Report discusses the conclusions drawn about air emissions impacts in the 2011 Charles River Associates report relating to an IPEC retirement analysis.[60] Do you have any comments on AAEA's discussion of this report?

A. Yes. As described above, the results of the 2011 CRA Retirement Report are premised on out of date assumptions. Furthermore, I note that the CRA percentage impact estimates provided in Table 1 of the AAEA Report reflect changes in emissions relative to a baseline with IPEC out of service. They do not represent changes in emissions relative to current emissions, nor do they reflect any form of absolute increase in emissions that would be seen in New York City during a period of outage of IPEC for cooling tower construction and installation. Table R3 above in this testimony illustrates the range of absolute emissions effects in New York City

[60] AAEA Report at 12.

under different scenarios of resource deployment based on the modeling Synapse conducted, as memorialized in the expert report[61] accompanying my Direct Testimony.

Q. The AAEA Report discusses a report generated by Synapse in 2011 entitled, "Indian Point Energy Center Nuclear Plant Retirement Analysis."[62] Do you have any comments on AAEA's discussion of this report?

A. Yes. AAEA's discussion references repowering of existing gas-fired power plants to purportedly indicate generally that air emissions will increase in environmental justice areas where such plants are located.[63] However, while gas-fired generation from New York City area plants would comprise just a fraction of replacement power if IPEC were out of service for closed-cycle cooling installation,[64] repowered facilities in New York City would have substantially lower per-unit NO_x emissions compared to the older steam or gas-turbine units they might replace, and substantially lower per-unit CO_2 emissions. The net effect of repowering older plants can be to decrease area emissions from electric power generation, even if increased amounts of energy are produced by those plants relative to production amounts from the older plants. This is particularly the case if replacement power needs (that in some scenarios, for some years, may be sourced from New York City area plants) come from new (e.g., repowered) combined cycle power plants instead of older, higher-emitting plants.

Q. The AAEA Report states that a closure of the James A. Fitzpatrick nuclear generating station "would neutralize any planned increase in transmission from upstate to downstate."[65] Do you have a response to this?

A. I don't agree with this characterization. Closure of any upstate power plants in general would not hinder, but, in fact, allow other upstate power plants to provide energy and capacity to downstate. Closure of such plants would generally not lower the level of planned increase in transmission from upstate to downstate, and would not imply that replacement power from any

[61] **Riverkeeper Exhibit 109**, Synapse IPEC Report.

[62] AAEA Report at 14; *see* **Riverkeeper Exhibit 124**, Synapse Energy Economics, Indian Point Energy Center Nuclear Plant Retirement Analysis (October 17, 2011).

[63] *See* AAEA Report at 14-15, 18-19.

[64] *See* **Riverkeeper Exhibit 109**, Synapse IPEC Report at Tables 1 and 2.

[65] AAEA Report at 15.

such closures would need to be sourced from downstate resources. In addition, increases in upstate wind resource availability could displace output from other power plants – nuclear or fossil-fueled – that might retire.

Q. The AAEA Report discusses "infrastructure challenges" that "tax [ConEd's] ability to reliably provide electricity to its customers."[66] Do you have a response to this?

A. Con Edison delivery challenges are local infrastructure issues that are generally not affected by any considerations of the availability of the IPEC units. Unavailability of IPEC due to outages for closed-cycle cooling installation would not change the nature of Con Edison's local distribution system infrastructure issues. Notably, improvements in local delivery system infrastructure, distribution or transmission – not an issue in this proceeding – will help to alleviate reliability requirements to use local generation resources, and allow for use of cleaner and/or less expensive generation from further away.

E. Response to Prefiled Submission of NYSDEC

Q. What issues are addressed in the testimonies of DPS Staff witnesses, submitted in support of NYSDEC?

A. The DPS Staff testimony of Mr. Gjonaj and Mr. Wheat addresses air emissions and energy price effects of IPEC outages for closed-cycle cooling installation using the GE MAPS modeling system. The DPS Staff testimony of Mr. Paynter addresses capacity market impacts associated with replacement capacity if IPEC was out of service for closed-cycle cooling installation.

Q. Are the NYS DPS Staff air impacts studies conducted on behalf of the staff of the NYSDEC ("DPS Studies") comparable to those conducted by Synapse?

A. Yes, but only to a fairly limited extent. I have compared the results of DPS Study Run 1 (R1) (2022) to Synapse scenarios 11 and 14 (for year 2022), and DPS Study Run 9 (R9) (2016) to Synapse scenarios 31 and 34 (for year 2016). This comparison roughly aligns the 2022

[66] AAEA Report at 31.

closed-cycle cooling outage assumption scenario of DPS Staff (R1, 42-week outage in year 2022, interim protective outages in each preceding year) with year 2022 of Synapse's bookend scenarios with IPEC out of service (scenarios 11 and 14, 52-week outage in year 2022); and it more closely aligns the IPEC outage assumption for 2016 (R9 assumes no closed-cycle cooling construction outages but instead a permanent seasonal outage of 62 unit outage days for both units, while Synapse assumed 60 outage days for both units in year 2016 as an interim measure prior to closed-cycle cooling construction). Both sets of analyses use fairly sophisticated locational and temporally-granular modeling tools, and electric power system information available through the NY ISO and the NYS DPS, among other sources. However, the set of assumptions used for transmission and gas-fired generation in-service differs between the two sets of analysis. Also, while Synapse tested the effect of increased energy efficiency and renewable resource deployment, the DPS Studies test air emissions impacts under just one set of going-forward conditions for energy efficiency and renewable resource deployment.

Q. Even though the two studies – yours and the DPS Studies – use different assumptions, and different modeling tools, in general are the findings consistent?

A. Yes. As I describe below, the findings are consistent, recognizing the factors in the modeling that drive the different outcomes.

Q. Please summarize the major differences between the analyses you performed and the DPS Studies R1 and R9 as best you can considering the information available.

A. The following summarizes the key assumption differences between Synapse's analysis and those NYS DPS Staff scenarios that are comparable to Synapse's modeling:

- **Different IPEC outage periods.** Synapse tested three outage scenarios: IPEC in-service for all years, 2015-2025 (our "baseline" scenario); IPEC out-of-service for all years 2016-2025 (our "bookend" scenario); and IPEC units sequentially offline for one-year periods for closed-cycle cooling installation in 2017 and 2018. The last of these outages scenarios includes IPEC units offline in 2016 for 60 days for an interim outage prior to the closed-cycle cooling equipment installation. The basis for these outage periods is

explained in my expert report. The DPS Studies evaluated both IPEC units concurrently out-of-service for closed-cycle cooling installation in 2022 for 42 weeks (Run1); and out of service for a 62-day outage period in 2016 (Run 9).

- **Different transmission assumptions for assets in place in 2022.** Synapse presumed the installation of the set of transmission reinforcements known as the Hudson Valley Reinforcement. These 345 kV transmission lines and associated equipment increase the transfer capacity across the major Central East, Total East, and UPNY/SENY transmission paths in New York State. Those assumptions were not in place in the DPS Studies.

- **Different gas-generation resources in place in baseline and alternative scenarios.** While all of the detailed gas-generation resource assumptions are not explicitly listed in the DPS Study testimonies, it appears that in 2022 the DPS Studies use new gas resources in the Millwood zone, while Synapse uses gas resources in the PROSYM G-H-I zone (CPV Valley in 2016, and Cricket Valley in 2018), and Synapse uses Astoria combined cycle repowered units (installed in stages between 2016 and 2018). Synapse also uses additional repowered units in 2022, while it is not clear if the DPS Studies also consider such additions.

- **Different baseline and alternative scenario renewable supply and demand-side resource deployment assumptions, affecting both 2022 and 2016 modelled years.** Synapse modelled scenarios with different amounts of energy efficiency, wind, and solar PV deployment in addition to a baseline scenario. The DPS studies used the same level of these resources in both baseline and scenario analyses. The differences between levels of these resources in the respective DPS Staff and Synapse baseline studies are not clear.

Q. Can you explain any differences in the methodology employed in the DPS Studies and in Synapse's analysis of air emissions impacts?

A. The tools used and the methodologies employed are similar. As previously indicated, Synapse used PROSYM to conduct air emissions modeling, while DPS Staff used GE MAPS.

While these two programs are both locational, hourly-based unit commitment and dispatch models, and are both valid industry tools, the outcomes from the models largely depends on the input assumptions, which are different in this matter. GE MAPS has the capability to model transmission system effects at a more granular locational level than the PROSYM model. The information provided in the DPS Staff witness direct testimony did not indicate how fine a granularity was used. For example, GE MAPS could model the intra-zone transmission constraints that would affect zone J (New York City) dispatch results. PROSYM does not model transmission constraints at that fine a level. As noted above, Synapse used different resource assumptions when estimating air emissions impacts.

Importantly, while the methodologies and assumptions employed by Synapse and DPS Staff differ, both are valid approaches.

Q. Mr. Gjonaj and Mr. Wheat describe the results of DPS Staff's air emissions forecast modeling.[67] Would you explain any differences in the outcomes of your and DPS Staff's respective analyses?

A. I have prepared Table R4 below that lists the most relevant comparative outcomes between the DPS modeling and the Synapse modeling, which demonstrates key similarities, and key differences, in the outcomes. It shows absolute differences (baseline minus scenario) in emissions of CO_2 and NO_x emissions for the DPS Studies and Synapse studies, the percentage change from baseline for each of the emissions for each modeling set, and lastly, the absolute levels of emissions for the different baselines and the different scenarios.

Table R4 shows that some similarities exist across the results for DPS and Synapse, but also demonstrates differences that can generally be attributed to the different resource assumptions used in each analysis.

[67] CCC Gjonaj & Wheat February 28, 2014 Direct at 15-16, 17-18; **NYSDEC Exhibit__(GW-4).**

Table R4. Comparison Between NYS DPS Studies and Synapse Studies – CO_2 and NO_X Air Emissions

2016 Comparison				Relative Values				Absolute Values			
				NYS CO_2		NYS NOx		NYS CO_2 millions tons		NYS NOx thousand tons	
NYS DPS Study or Synapse Run	Scenario Designation	Type of IPEC outage	Year of Model Run	Difference, absolute from base, Tons	% from base	Difference, absolute from base, Tons	% from base	Base	Scen.	Base	Scen.
DPS Study	R9	Protective outage 62 days	2016	981,426	2.6%	546	2.5%	38.3	39.3	21.9	22.5
Synapse	Sc 31	Interim outage 60 days	2016	783,109	2.1%	800	4.4%	38.2	39.0	18.1	18.9
With Increased Energy Efficiency, Wind and Solar PV Resource Deployment											
Synapse	Sc. 34	Interim outage 60 days	2016	(5,074,591)	-13.3%	(4,836)	-26.8%	38.2	33.1	18.1	13.2
2022 Comparison				NYS CO_2		NYS NOx		NYS CO_2 millions tons		NYS NOx thousand tons	
NYS DPS Study or Synapse Run	Scenario Designation	Type of IPEC outage	Year of Model Run	Difference, absolute from base, Tons	% from base	Difference, absolute from base, Tons	% from base	Base	Scen.	Base	Scen.
DPS Study	R1	42 weeks	2022	5,057,580	13.7%	1,512	7.4%	36.9	41.9	20.6	22.1
Synapse	Sc 11	Fully OOS 52 weeks	2022	4,887,209	13.7%	1,555	12.7%	35.7	40.6	12.3	13.8
With Increased Energy Efficiency, Wind and Solar PV Resource Deployment											
Synapse	Sc. 14	Fully OOS 52 weeks	2022	(1,287,800)	-3.6%	(1,609)	-13.1%	35.7	34.4	12.3	10.7

Source: Synapse PROSYM Modeling (Appendix A Data); NYS DPS Studies (Exhibit__(GW-3) and Exhibit__(GW-4))

Table R4 shows that 2016 baseline scenario emissions of CO_2 and NO_x are very close between the DPS Studies and the Synapse scenarios. Synapse scenario 31 CO_2 emission values are slightly lower and scenario 34 values are much lower than DPS Staff scenario values (with high energy efficiency, wind and solar PV installations beginning to affect the system by 2016 in Synapse scenario 34). Comparing values between the scenarios is best done with the absolute quantities, since the baselines are different. Synapse scenario 31 NO_x emissions in 2016 are more significantly lower than the DPS Studies (compared to CO_2 emission differences between the studies), likely reflecting the effect of the increased amount of newer gas-fired resource installation reflected in the Synapse modeling.

In 2022, similar magnitude effects are shown, and again the Synapse scenario 14 with higher levels of energy efficiency, wind, and solar PV show considerably lower absolute amounts of CO_2 and NO_x emissions compared to the DPS Studies.

Q. Please discuss the significance of the differences between the outcome of the DPS Studies and Synapse's analysis of air emissions impacts associated with IPEC outages for closed-cycle cooling installation.

A. Both outcomes are valid. The source of the differences can likely be traced to different baseline and scenario assumptions reflecting net load of energy efficiency, transmission effects, levels of renewable resources, and the gas-fired resource base in each of the models, along with slightly different 2022 outage periods for the IPEC units.

While the assumptions used in the different studies vary, the overall conclusion remains the same – emissions effects are minimal for closed-cycle cooling installation, and if consideration is given to increased deployment of energy efficiency, wind and solar PV resources, emissions impacts are even lower than baseline scenarios with IPEC units in service.

Q. Does the Synapse modeling allow you to draw any conclusions regarding air emissions impacts if construction outages for closed-cycle cooling occur in the year 2022 (as modelled by DPS)?

A. Yes. I can evaluate year 2022 of the Synapse scenarios in isolation from other years, and use it in comparison to DPS Studies runs for 2022. Based on the data generated by Synapse, emission effects are minimal for closed-cycle cooling construction occurring in year 2022, as well as for the 62-day protective outage modelled in 2016 in the DPS Studies.

Q. Are these results consistent with DPS Staff's results?

A. Yes, they are consistent, but generally since our baselines are slightly different and the demand-side, supply side, and transmission (in 2022) deployments are different, modelled emissions levels vary, with Synapse studies showing lower levels of emissions.

Q. Mr. Gjonaj and Mr. Wheat describe the results of DPS Staff's wholesale market impact forecasting.[68] Would you explain any differences in the outcomes of your analysis and those of Mr. Gjonaj and Mr. Wheat?

A. Synapse's projections of energy price increases (or decreases with scenarios with greater levels of energy efficiency, wind, and solar PV deployment) are less than seen in the DPS Studies for the 2022 year comparison.[69] The differences can likely be explained by the presence of additional gas-fired combined cycle generation in Synapse's modeling and the presence of additional transmission infrastructure. The Synapse scenarios with increased energy efficiency and renewables deployments explains the lower prices (than baseline) for those scenarios, as seen in Table 15 in Synapse's report. Under instances of increased deployment of energy efficiency, wind, and PV resources, as seen in Synapse scenario 14 in 2022, price increases from the baseline are fully mitigated.

Overall, both analyses show relatively small changes in energy prices.

Q. DPS Staff witness on behalf of NYSDEC, Thomas S. Paynter, testifies in regards to wholesale capacity market impacts from IPEC outage scenarios. In your opinion, does his testimony sufficiently address relevant variables which affect wholesale capacity market impacts?

A. Yes, Mr. Paynter accurately assesses the sensitivity of capacity market price effects in the New York City zone to relatively small movements of capacity supply and need. This fundamental characteristic of New York's capacity markets implies that any estimates of capacity price movements must carefully consider the underlying fundamentals, which include the ability of demand-side programs to lower prices, and for transmission improvements that allow reduction of requirements to also lower prices.

[68] CCC Gjonaj & Wheat February 28, 2014 Direct at 16-17; **NYSDEC Exhibit GW-5.**

[69] **Riverkeeper Exhibit 109**, Synapse IPEC Report at Tables 14 and 15, at p. 39, in comparison to DPS Exhibit__(GW-5), for R1.

F. Conclusion

Q. Please summarize your conclusions with respect to the direct testimonies and exhibits submitted by Entergy, NYC, AAEA, and NYSDEC in this proceeding relating to electric system reliability and power sector air emission impacts associated with the implementation of closed-cycle cooling at IPEC.

A. The Entergy and NYC analyses omit key approved or planned transmission increases in their analyses. Resource development assumptions in both analyses are relatively limited, and thus the assessments of air emissions impact are not robust across different possible levels of deployment of energy efficiency and renewable resources. Entergy and NYC's reliability conclusions are premised on stale analyses and/or do not include updated assumptions. The AAEA report does not provide any specific analysis of New York City air emissions impacts associated with the construction of closed-cycle cooling at IPEC. And finally, DPS's analysis on behalf of NYSDEC generally show minimal air emissions impacts for the construction of closed-cycle cooling.

Overall, there is nothing that I have reviewed in the Entergy, NYC, or AAEA analyses that changes the findings and opinion set out in my expert report and Direct Testimony. Moreover, I agree with the thrust of the NYS DEC findings of minimal air emissions impacts associated with closed-cycle cooling installation at IPEC.

Q. Do you hold all of the opinions expressed in your rebuttal testimony to a reasonable degree of scientific certainty?

A. Yes.

Q. Does this conclude your rebuttal testimony?

A. Yes.

Supplemental Bibliography

State of New York Public Service Commission. *Order Approving EEPS Program Changes, Case 07-M-0548,* Proceeding on Motion of the Commission Regarding an Energy Efficiency Portfolio Standard. Issued and Effective December 26, 2013.

Synapse Energy Economics, Indian Point Energy Center Nuclear Plant Retirement Analysis (October 17, 2011)

Appendix A: Additional Modeling Data Tables

NO_X and CO_2 output by zone by year by scenario, scenarios 1, 11, 14, 31, 34

Scenario 1 - IPEC in base EE, Wind, PV	GWh										% Change from Sc. 1	% Change from 2015 this Scenario
	Nuclear	Hydro&PS	NatGas	Coal	Oil 6	Oil 2	Ker	Wind	Other (Wood, Refuse, Bio, PV, DR/LaaR)	Total		
2015 Total All Zones	**39,975**	**27,273**	**67,425**	**5,376**	**-**	**6**	**1**	**5,865**	**3,146**	**149,066**	0.0%	0.0%
NY-AB (West)	4,151	14,891	1,928	4,924	-	-	-	1,072	828	27,793	0.0%	0.0%
NY-CDE (Cent North)	20,408	9,481	9,427	452	-	-	-	4,737	818	45,322	0.0%	0.0%
NY-F (Capital)	-	2,583	17,839	-	-	-	-	55	153	20,630	0.0%	0.0%
NY-GHI (Southeast)	15,417	318	746	-	-	-	-	-	535	17,016	0.0%	0.0%
NY-J (NY City)	-	-	25,909	-	-	-	-	-	54	25,964	0.0%	0.0%
NY-K (Long Island)	-	-	11,576	-	-	6	1	-	758	12,342	0.0%	0.0%
2016 Total All Zones	**39,502**	**27,303**	**71,323**	**4,961**	**-**	**19**	**3**	**5,884**	**3,287**	**152,283**	0.0%	2.2%
NY-AB (West)	4,487	14,897	1,886	4,527	-	-	-	1,077	831	27,704	0.0%	-0.3%
NY-CDE (Cent North)	19,587	9,481	9,223	434	-	-	-	4,752	823	44,300	0.0%	-2.3%
NY-F (Capital)	-	2,608	17,522	-	-	-	-	55	153	20,339	0.0%	-1.4%
NY-GHI (Southeast)	15,428	318	4,269	-	-	0	-	-	535	20,550	0.0%	20.8%
NY-J (NY City)	-	-	26,837	-	-	2	-	-	182	27,021	0.0%	4.1%
NY-K (Long Island)	-	-	11,586	-	-	18	3	-	762	12,369	0.0%	0.2%
2017 Total All Zones	**39,941**	**27,352**	**71,176**	**4,556**	**3**	**8**	**2**	**6,121**	**3,278**	**152,436**	0.0%	2.3%
NY-AB (West)	4,113	14,894	1,794	4,129	-	-	-	1,071	829	26,830	0.0%	-3.5%
NY-CDE (Cent North)	20,407	9,481	8,866	427	3	-	-	4,994	822	44,999	0.0%	-0.7%
NY-F (Capital)	-	2,659	16,348	-	-	-	-	55	153	19,215	0.0%	-6.9%
NY-GHI (Southeast)	15,421	318	5,854	-	-	-	-	-	533	22,126	0.0%	30.0%
NY-J (NY City)	-	-	27,176	-	-	0	-	-	184	27,361	0.0%	5.4%
NY-K (Long Island)	-	-	11,138	-	-	8	2	-	757	11,904	0.0%	-3.5%
2018 Total All Zones	**39,069**	**32,847**	**70,248**	**3,159**	**-**	**3**	**1**	**6,123**	**3,246**	**154,695**	0.0%	3.8%
NY-AB (West)	4,149	14,870	1,619	2,761	-	-	-	1,071	820	25,291	0.0%	-9.0%
NY-CDE (Cent North)	19,531	9,481	8,075	398	-	-	-	4,996	821	43,302	0.0%	-4.5%
NY-F (Capital)	-	2,483	12,542	-	-	-	-	55	153	15,233	0.0%	-26.2%
NY-GHI (Southeast)	15,388	318	12,568	-	-	-	-	-	532	28,807	0.0%	69.3%
NY-J (NY City)	-	5,694	24,914	-	-	-	-	-	167	30,775	0.0%	18.5%
NY-K (Long Island)	-	-	10,530	-	-	3	1	-	753	11,286	0.0%	-8.6%
2019 Total All Zones	**40,298**	**32,863**	**69,651**	**3,231**	**-**	**4**	**1**	**6,128**	**3,252**	**155,428**	0.0%	4.3%
NY-AB (West)	4,474	14,878	1,603	2,832	-	-	-	1,072	826	25,685	0.0%	-7.6%
NY-CDE (Cent North)	20,399	9,481	8,123	399	-	-	-	5,001	824	44,227	0.0%	-2.4%
NY-F (Capital)	-	2,492	12,023	-	-	-	-	55	153	14,723	0.0%	-28.6%
NY-GHI (Southeast)	15,425	318	12,505	-	-	-	-	-	532	28,781	0.0%	69.1%
NY-J (NY City)	-	5,694	24,779	-	-	-	-	-	166	30,639	0.0%	18.0%
NY-K (Long Island)	-	-	10,619	-	-	4	1	-	751	11,374	0.0%	-7.8%
2020 Total All Zones	**39,149**	**32,885**	**73,053**	**2,221**	**-**	**3**	**1**	**6,458**	**3,253**	**157,022**	0.0%	5.3%
NY-AB (West)	4,126	14,882	1,588	1,864	-	-	-	1,077	820	24,358	0.0%	-12.4%
NY-CDE (Cent North)	19,586	9,481	7,999	357	-	-	-	5,326	826	43,574	0.0%	-3.9%
NY-F (Capital)	-	2,509	12,496	-	-	-	-	55	153	15,214	0.0%	-26.3%
NY-GHI (Southeast)	15,436	318	15,321	-	-	-	-	-	533	31,609	0.0%	85.8%
NY-J (NY City)	-	5,694	25,132	-	-	-	-	-	165	30,991	0.0%	19.4%
NY-K (Long Island)	-	-	10,517	-	-	3	1	-	754	11,276	0.0%	-8.6%
2021 Total All Zones	**39,977**	**32,856**	**77,106**	**2,098**	**9**	**2**	**1**	**7,145**	**3,299**	**162,493**	0.0%	9.0%
NY-AB (West)	4,151	14,875	1,574	1,753	-	-	-	1,315	821	24,489	0.0%	-11.9%
NY-CDE (Cent North)	20,405	9,481	7,856	345	9	-	-	5,775	855	44,725	0.0%	-1.3%
NY-F (Capital)	-	2,488	11,134	-	-	-	-	55	165	13,842	0.0%	-32.9%
NY-GHI (Southeast)	15,422	318	17,985	-	-	-	-	-	532	34,257	0.0%	101.3%
NY-J (NY City)	-	5,694	26,141	-	-	-	-	-	170	32,005	0.0%	23.3%
NY-K (Long Island)	-	-	12,417	-	-	2	1	-	756	13,175	0.0%	6.8%
2022 Total All Zones	**39,389**	**32,860**	**78,111**	**1,683**	**-**	**2**	**1**	**7,675**	**3,300**	**163,021**	0.0%	9.4%
NY-AB (West)	4,475	14,877	1,517	1,350	-	-	-	1,539	818	24,576	0.0%	-11.6%
NY-CDE (Cent North)	19,535	9,481	7,706	333	-	-	-	6,081	862	43,997	0.0%	-2.9%
NY-F (Capital)	-	2,490	10,929	-	-	-	-	55	165	13,639	0.0%	-33.9%
NY-GHI (Southeast)	15,379	318	17,841	-	-	-	-	-	532	34,071	0.0%	100.2%
NY-J (NY City)	-	5,694	27,789	-	-	-	-	-	168	33,651	0.0%	29.6%
NY-K (Long Island)	-	-	12,328	-	-	2	1	-	755	13,087	0.0%	6.0%
2023 Total All Zones	**39,926**	**32,914**	**78,142**	**1,801**	**-**	**3**	**1**	**8,193**	**3,374**	**164,354**	0.0%	10.3%
NY-AB (West)	4,114	14,884	1,507	1,464	-	-	-	1,536	819	24,324	0.0%	-12.5%
NY-CDE (Cent North)	20,396	9,481	7,617	337	-	-	-	6,602	934	45,367	0.0%	0.1%
NY-F (Capital)	-	2,536	10,907	-	-	-	-	55	165	13,664	0.0%	-33.8%
NY-GHI (Southeast)	15,416	318	17,970	-	-	-	-	-	532	34,235	0.0%	101.2%
NY-J (NY City)	-	5,694	27,818	-	-	-	-	-	166	33,678	0.0%	29.7%
NY-K (Long Island)	-	-	12,322	-	-	3	1	-	759	13,086	0.0%	6.0%
2024 Total All Zones	**39,182**	**32,972**	**78,632**	**1,985**	**-**	**1**	**0**	**9,123**	**3,386**	**165,280**	0.0%	10.9%
NY-AB (West)	4,162	14,887	1,508	1,639	-	-	-	1,544	818	24,558	0.0%	-11.6%
NY-CDE (Cent North)	19,590	9,481	7,601	346	-	-	-	6,915	946	44,878	0.0%	-1.0%
NY-F (Capital)	-	2,592	10,448	-	-	-	-	55	166	13,261	0.0%	-35.7%
NY-GHI (Southeast)	15,430	318	17,447	-	-	-	-	-	533	33,728	0.0%	98.2%
NY-J (NY City)	-	5,694	27,279	-	-	-	-	-	165	33,138	0.0%	27.6%
NY-K (Long Island)	-	-	14,349	-	-	1	0	609	759	15,717	0.0%	27.3%
2025 Total All Zones	**40,287**	**32,984**	**80,435**	**1,824**	**-**	**0**	**-**	**9,158**	**3,521**	**168,209**	0.0%	12.8%
NY-AB (West)	4,473	14,896	1,494	1,485	-	-	-	1,539	810	24,697	0.0%	-11.1%
NY-CDE (Cent North)	20,397	9,481	7,436	339	-	-	-	6,900	1,083	45,636	0.0%	0.7%
NY-F (Capital)	-	2,595	9,444	-	-	-	-	55	165	12,259	0.0%	-40.6%
NY-GHI (Southeast)	15,417	318	16,477	-	-	-	-	-	531	32,744	0.0%	92.4%
NY-J (NY City)	-	5,694	29,069	-	-	-	-	55	165	34,983	0.0%	34.7%
NY-K (Long Island)	-	-	16,514	-	-	0	-	608	767	17,890	0.0%	45.0%

Scenario 11 - IPEC OOS base EE, Wind, PV	GWh										% Change from Sc. 1	% Change from 2015 this Scenario
	Nuclear	Hydro&PS	NatGas	Coal	Oil 6	Oil 2	Ker	Wind	Other (Wood, Refuse, Blo, PV, DR/LaaR)	Total		
2015 Total All Zones	**39,975**	**27,273**	**67,425**	**5,376**	**-**	**6**	**1**	**5,865**	**3,146**	**149,066**	0.0%	0.0%
NY-AB (West)	4,151	14,891	1,928	4,924	-	-	-	1,072	828	27,793	0.0%	0.0%
NY-CDE (Cent North)	20,408	9,481	9,427	452	-	-	-	4,737	818	45,322	0.0%	0.0%
NY-F (Capital)	-	2,583	17,839	-	-	-	-	55	153	20,630	0.0%	0.0%
NY-GHI (Southeast)	15,417	318	746	-	-	-	-	-	535	17,016	0.0%	0.0%
NY-J (NY City)	-	-	25,909	-	-	-	-	-	54	25,964	0.0%	0.0%
NY-K (Long Island)	-	-	11,576	-	-	6	1	-	758	12,342	0.0%	0.0%
2016 Total All Zones	**24,074**	**27,303**	**80,053**	**5,906**	**12**	**30**	**4**	**5,884**	**3,331**	**146,597**	-3.7%	-1.7%
NY-AB (West)	4,487	14,897	2,177	5,436	-	-	-	1,077	837	28,910	4.4%	4.0%
NY-CDE (Cent North)	19,587	9,481	10,219	470	12	-	-	4,752	825	45,347	2.4%	0.1%
NY-F (Capital)	-	2,608	19,960	-	-	-	-	55	154	22,778	12.0%	10.4%
NY-GHI (Southeast)	-	318	5,350	-	-	1	-	-	550	6,218	-69.7%	-63.5%
NY-J (NY City)	-	-	29,916	-	-	2	-	-	199	30,117	11.5%	16.0%
NY-K (Long Island)	-	-	12,430	-	-	28	4	-	766	13,228	6.9%	7.2%
2017 Total All Zones	**24,519**	**27,352**	**80,283**	**5,444**	**31**	**17**	**3**	**6,121**	**3,301**	**147,071**	-3.5%	-1.3%
NY-AB (West)	4,113	14,894	2,058	4,987	-	-	-	1,071	835	27,957	4.2%	0.6%
NY-CDE (Cent North)	20,407	9,481	9,791	457	31	-	-	4,994	824	45,985	2.2%	1.5%
NY-F (Capital)	-	2,659	19,312	-	-	-	-	55	153	22,179	15.4%	7.5%
NY-GHI (Southeast)	-	318	6,995	-	-	0	-	-	542	7,855	-64.5%	-53.8%
NY-J (NY City)	-	-	30,257	-	-	1	-	-	188	30,446	11.3%	17.3%
NY-K (Long Island)	-	-	11,870	-	-	16	3	-	759	12,648	6.2%	2.5%
2018 Total All Zones	**23,681**	**32,847**	**80,885**	**4,126**	**-**	**4**	**1**	**6,123**	**3,268**	**150,935**	-2.4%	1.3%
NY-AB (West)	4,149	14,870	1,774	3,699	-	-	-	1,071	827	26,391	4.3%	-5.0%
NY-CDE (Cent North)	19,531	9,481	8,849	427	-	-	-	4,996	824	44,108	1.9%	-2.7%
NY-F (Capital)	-	2,483	16,228	-	-	-	-	55	153	18,920	24.2%	-8.3%
NY-GHI (Southeast)	-	318	14,591	-	-	-	-	-	537	15,446	-46.4%	-9.2%
NY-J (NY City)	-	5,694	28,536	-	-	-	-	-	172	34,403	11.8%	32.5%
NY-K (Long Island)	-	-	10,909	-	-	4	1	-	754	11,668	3.4%	-5.5%
2019 Total All Zones	**24,873**	**32,863**	**80,318**	**4,150**	**7**	**5**	**1**	**6,128**	**3,265**	**151,610**	-2.5%	1.7%
NY-AB (West)	4,474	14,878	1,780	3,722	-	-	-	1,072	833	26,760	4.2%	-3.7%
NY-CDE (Cent North)	20,399	9,481	8,865	428	7	-	-	5,001	828	45,007	1.8%	-0.7%
NY-F (Capital)	-	2,492	15,819	-	-	-	-	55	153	18,520	25.8%	-10.2%
NY-GHI (Southeast)	-	318	14,504	-	-	-	-	-	533	15,355	-46.6%	-9.8%
NY-J (NY City)	-	5,694	28,357	-	-	-	-	-	166	34,217	11.7%	31.8%
NY-K (Long Island)	-	-	10,992	-	-	5	1	-	752	11,750	3.3%	-4.8%
2020 Total All Zones	**23,713**	**32,885**	**83,767**	**3,008**	**-**	**4**	**1**	**6,458**	**3,264**	**153,100**	-2.5%	2.7%
NY-AB (West)	4,126	14,882	1,749	2,623	-	-	-	1,077	828	25,285	3.8%	-9.0%
NY-CDE (Cent North)	19,586	9,481	8,791	385	-	-	-	5,326	829	44,399	1.9%	-2.0%
NY-F (Capital)	-	2,509	16,557	-	-	-	-	55	154	19,275	26.7%	-6.6%
NY-GHI (Southeast)	-	318	17,568	-	-	-	-	-	534	18,420	-41.7%	8.2%
NY-J (NY City)	-	5,694	28,239	-	-	-	-	-	165	34,099	10.0%	31.3%
NY-K (Long Island)	-	-	10,863	-	-	4	1	-	754	11,622	3.1%	-5.8%
2021 Total All Zones	**24,555**	**32,856**	**87,699**	**2,814**	**10**	**3**	**1**	**7,145**	**3,310**	**158,392**	-2.5%	6.3%
NY-AB (West)	4,151	14,875	1,678	2,442	-	-	-	1,315	828	25,288	3.3%	-9.0%
NY-CDE (Cent North)	20,405	9,481	8,574	373	10	-	-	5,775	858	45,475	1.7%	0.3%
NY-F (Capital)	-	2,488	15,099	-	-	-	-	55	166	17,808	28.6%	-13.7%
NY-GHI (Southeast)	-	318	20,139	-	-	-	-	-	532	20,990	-38.7%	23.4%
NY-J (NY City)	-	5,694	29,431	-	-	0	-	-	170	35,295	10.3%	35.9%
NY-K (Long Island)	-	-	12,777	-	-	2	1	-	756	13,537	2.7%	9.7%
2022 Total All Zones	**24,010**	**32,860**	**88,778**	**2,397**	**-**	**2**	**0**	**7,675**	**3,312**	**159,036**	-2.4%	6.7%
NY-AB (West)	4,475	14,877	1,619	2,034	-	-	-	1,539	826	25,370	3.2%	-8.7%
NY-CDE (Cent North)	19,535	9,481	8,381	363	-	-	-	6,081	864	44,705	1.6%	-1.4%
NY-F (Capital)	-	2,490	14,662	-	-	-	-	55	166	17,373	27.4%	-15.8%
NY-GHI (Southeast)	-	318	20,076	-	-	-	-	-	532	20,927	-38.6%	23.0%
NY-J (NY City)	-	5,694	31,337	-	-	-	-	-	169	37,199	10.5%	43.3%
NY-K (Long Island)	-	-	12,704	-	-	2	0	-	755	13,461	2.9%	9.1%
2023 Total All Zones	**24,510**	**32,914**	**88,475**	**2,655**	**6**	**5**	**1**	**8,193**	**3,386**	**160,146**	-2.6%	7.4%
NY-AB (West)	4,114	14,884	1,598	2,290	-	-	-	1,536	827	25,249	3.8%	-9.2%
NY-CDE (Cent North)	20,396	9,481	8,259	365	6	-	-	6,602	937	46,046	1.5%	1.6%
NY-F (Capital)	-	2,536	14,526	-	-	-	-	55	166	17,283	26.5%	-16.2%
NY-GHI (Southeast)	-	318	20,023	-	-	-	-	-	533	20,873	-39.0%	22.7%
NY-J (NY City)	-	5,694	31,381	-	-	-	-	-	165	37,240	10.6%	43.4%
NY-K (Long Island)	-	-	12,689	-	-	5	1	-	759	13,454	2.8%	9.0%
2024 Total All Zones	**23,752**	**32,972**	**88,971**	**2,799**	**-**	**1**	**0**	**9,123**	**3,399**	**161,017**	-2.6%	8.0%
NY-AB (West)	4,162	14,887	1,584	2,432	-	-	-	1,544	825	25,435	3.6%	-8.5%
NY-CDE (Cent North)	19,590	9,481	8,156	367	-	-	-	6,915	950	45,459	1.3%	0.3%
NY-F (Capital)	-	2,592	14,025	-	-	-	-	55	166	16,839	27.0%	-18.4%
NY-GHI (Southeast)	-	318	19,786	-	-	-	-	-	534	20,638	-38.8%	21.3%
NY-J (NY City)	-	5,694	30,534	-	-	-	-	-	165	36,393	9.8%	40.2%
NY-K (Long Island)	-	-	14,885	-	-	1	0	609	759	16,253	3.4%	31.7%
2025 Total All Zones	**24,870**	**32,984**	**91,211**	**2,341**	**9**	**0**	**-**	**9,158**	**3,542**	**164,115**	-2.4%	10.1%
NY-AB (West)	4,473	14,896	1,567	1,982	-	-	-	1,539	819	25,277	2.3%	-9.1%
NY-CDE (Cent North)	20,397	9,481	7,945	359	9	-	-	6,900	1,093	46,184	1.2%	1.9%
NY-F (Capital)	-	2,595	12,403	-	-	-	-	55	166	15,218	24.1%	-26.2%
NY-GHI (Southeast)	-	318	18,995	-	-	-	-	-	532	19,846	-39.4%	16.6%
NY-J (NY City)	-	5,694	33,144	-	-	-	-	55	165	39,058	11.6%	50.4%
NY-K (Long Island)	-	-	17,157	-	-	0	-	608	767	18,533	3.6%	50.2%

GWh											% Change from Sc. 1	% Change from 2015 this Scenario
Scenario 14 - IPEC OOS HI EE, Wind, PV	Nuclear	Hydro&PS	NatGas	Coal	Oil 6	Oil 2	Ker	Wind	Other (Wood, Refuse, Bio, PV, DR/LaaR)	Total		
2015 Total All Zones	**39,975**	**27,317**	**62,171**	**4,913**	**-**	**4**	**0**	**5,865**	**4,035**	**144,281**	**-3.2%**	**0.0%**
NY-AB (West)	4,151	14,895	1,787	4,485	-	-	-	1,072	1,008	27,397	-1.4%	0.0%
NY-CDE (Cent North)	20,408	9,481	8,924	428	-	-	-	4,737	1,001	44,978	-0.8%	0.0%
NY-F (Capital)	-	2,624	16,488	-	-	-	-	55	348	19,515	-5.4%	0.0%
NY-GHI (Southeast)	15,417	318	415	-	-	-	-	-	627	16,776	-1.4%	0.0%
NY-J (NY City)	-	-	23,784	-	-	-	-	-	137	23,921	-7.9%	0.0%
NY-K (Long Island)	-	-	10,774	-	-	4	0	-	914	11,693	-5.3%	0.0%
2016 Total All Zones	**24,074**	**27,298**	**77,256**	**520**	**-**	**20**	**3**	**5,884**	**4,708**	**139,765**	**-8.2%**	**-3.1%**
NY-AB (West)	4,487	14,899	2,223	64	-	-	-	1,077	1,136	23,887	-13.8%	-12.8%
NY-CDE (Cent North)	19,587	9,481	10,140	456	-	-	-	4,752	1,124	45,540	2.8%	1.2%
NY-F (Capital)	-	2,600	19,462	-	-	-	-	55	461	22,578	11.0%	15.7%
NY-GHI (Southeast)	-	318	5,133	-	-	1	-	-	688	6,140	-70.1%	-63.4%
NY-J (NY City)	-	-	28,441	-	-	1	-	-	328	28,771	6.5%	20.3%
NY-K (Long Island)	-	-	11,856	-	-	18	3	-	971	12,849	3.9%	9.9%
2017 Total All Zones	**24,519**	**27,307**	**76,749**	**493**	**3**	**9**	**1**	**6,121**	**5,167**	**140,369**	**-7.9%**	**-2.7%**
NY-AB (West)	4,113	14,894	2,067	52	-	-	-	1,071	1,245	23,441	-12.6%	-14.4%
NY-CDE (Cent North)	20,407	9,481	9,599	441	3	-	-	4,994	1,235	46,160	2.6%	2.6%
NY-F (Capital)	-	2,615	18,495	-	-	-	-	55	569	21,734	13.1%	11.4%
NY-GHI (Southeast)	-	318	6,676	-	-	0	-	-	729	7,723	-65.1%	-54.0%
NY-J (NY City)	-	-	28,678	-	-	0	-	-	373	29,052	6.2%	21.4%
NY-K (Long Island)	-	-	11,234	-	-	8	1	-	1,015	12,259	3.0%	4.8%
2018 Total All Zones	**23,681**	**32,775**	**74,950**	**435**	**-**	**3**	**1**	**7,265**	**5,577**	**144,686**	**-6.5%**	**0.3%**
NY-AB (West)	4,149	14,864	1,739	26	-	-	-	1,459	1,339	23,577	-6.8%	-13.9%
NY-CDE (Cent North)	19,531	9,481	8,554	409	-	-	-	5,731	1,338	45,043	4.0%	0.1%
NY-F (Capital)	-	2,418	14,376	-	-	-	-	75	678	17,547	15.2%	-10.1%
NY-GHI (Southeast)	-	318	13,992	-	-	-	-	-	768	15,078	-47.7%	-10.1%
NY-J (NY City)	-	5,694	26,132	-	-	-	-	-	400	32,226	4.7%	34.7%
NY-K (Long Island)	-	-	10,157	-	-	3	1	-	1,054	11,215	-0.6%	-4.1%
2019 Total All Zones	**24,873**	**32,760**	**73,570**	**434**	**-**	**2**	**-**	**8,419**	**6,057**	**146,114**	**-6.0%**	**1.3%**
NY-AB (West)	4,474	14,866	1,726	24	-	-	-	1,850	1,457	24,397	-5.0%	-11.0%
NY-CDE (Cent North)	20,399	9,481	8,566	410	-	-	-	6,475	1,455	46,785	5.8%	4.0%
NY-F (Capital)	-	2,401	13,577	-	-	-	-	95	786	16,859	14.5%	-13.6%
NY-GHI (Southeast)	-	318	13,809	-	-	-	-	-	814	14,941	-48.1%	-10.9%
NY-J (NY City)	-	5,694	25,713	-	-	-	-	-	446	31,853	4.0%	33.2%
NY-K (Long Island)	-	-	10,180	-	-	2	-	-	1,098	11,279	-0.8%	-3.5%
2020 Total All Zones	**23,713**	**32,726**	**75,265**	**371**	**-**	**1**	**-**	**9,907**	**6,535**	**148,518**	**-5.4%**	**2.9%**
NY-AB (West)	4,126	14,855	1,669	4	-	-	-	2,248	1,563	24,465	0.4%	-10.7%
NY-CDE (Cent North)	19,586	9,481	8,340	367	-	-	-	7,544	1,569	46,887	7.6%	4.2%
NY-F (Capital)	-	2,378	13,501	-	-	-	-	115	898	16,893	11.0%	-13.4%
NY-GHI (Southeast)	-	318	16,397	-	-	-	-	-	863	17,579	-44.4%	4.8%
NY-J (NY City)	-	5,694	25,337	-	-	-	-	-	494	31,525	1.7%	31.8%
NY-K (Long Island)	-	-	10,021	-	-	1	-	-	1,148	11,170	-0.9%	-4.5%
2021 Total All Zones	**24,555**	**32,730**	**78,518**	**353**	**-**	**1**	**0**	**11,740**	**7,051**	**154,949**	**-4.6%**	**7.4%**
NY-AB (West)	4,151	14,854	1,618	0	-	-	-	2,875	1,674	25,171	2.8%	-8.1%
NY-CDE (Cent North)	20,405	9,481	8,062	352	-	-	-	8,730	1,708	48,737	9.0%	8.4%
NY-F (Capital)	-	2,383	12,000	-	-	-	-	135	1,022	15,540	12.3%	-20.4%
NY-GHI (Southeast)	-	318	18,748	-	-	-	-	-	909	19,975	-41.7%	19.1%
NY-J (NY City)	-	5,694	26,177	-	-	-	-	-	543	32,414	1.3%	35.5%
NY-K (Long Island)	-	-	11,913	-	-	1	0	-	1,196	13,111	-0.5%	12.1%
2022 Total All Zones	**24,012**	**32,749**	**78,202**	**332**	**-**	**1**	**-**	**13,415**	**7,517**	**156,229**	**-4.2%**	**8.3%**
NY-AB (West)	4,475	14,853	1,553	-	-	-	-	3,488	1,777	26,146	6.4%	-4.6%
NY-CDE (Cent North)	19,537	9,481	7,823	332	-	-	-	9,773	1,822	48,767	10.8%	8.4%
NY-F (Capital)	-	2,402	11,219	-	-	-	-	155	1,132	14,908	9.3%	-23.6%
NY-GHI (Southeast)	-	318	18,183	-	-	-	-	-	957	19,458	-42.9%	16.0%
NY-J (NY City)	-	5,694	27,668	-	-	-	-	-	589	33,952	0.9%	41.9%
NY-K (Long Island)	-	-	11,756	-	-	1	-	-	1,241	12,998	-0.7%	11.2%
2023 Total All Zones	**24,510**	**32,785**	**77,277**	**339**	**-**	**1**	**0**	**15,051**	**8,050**	**158,012**	**-3.9%**	**9.5%**
NY-AB (West)	4,114	14,859	1,529	1	-	-	-	3,864	1,883	26,250	7.9%	-4.2%
NY-CDE (Cent North)	20,396	9,481	7,658	338	-	-	-	11,012	2,000	50,885	12.2%	13.1%
NY-F (Capital)	-	2,432	10,896	-	-	-	-	174	1,241	14,743	7.9%	-24.5%
NY-GHI (Southeast)	-	318	18,336	-	-	-	-	-	1,003	19,658	-42.6%	17.2%
NY-J (NY City)	-	5,694	27,159	-	-	-	-	-	636	33,489	-0.6%	40.0%
NY-K (Long Island)	-	-	11,699	-	-	1	0	-	1,288	12,988	-0.7%	11.1%
2024 Total All Zones	**23,752**	**32,810**	**77,003**	**341**	**-**	**-**	**-**	**17,165**	**8,036**	**159,106**	**-3.7%**	**10.3%**
NY-AB (West)	4,162	14,858	1,519	-	-	-	-	4,275	1,871	26,686	8.7%	-2.6%
NY-CDE (Cent North)	19,590	9,481	7,565	341	-	-	-	12,086	2,002	51,065	13.8%	13.5%
NY-F (Capital)	-	2,459	10,269	-	-	-	-	195	1,238	14,161	6.8%	-27.4%
NY-GHI (Southeast)	-	318	17,548	-	-	-	-	-	1,003	18,869	-44.1%	12.5%
NY-J (NY City)	-	5,694	26,267	-	-	-	-	-	635	32,595	-1.6%	36.3%
NY-K (Long Island)	-	-	13,835	-	-	-	-	609	1,287	15,731	0.1%	34.5%
2025 Total All Zones	**24,870**	**32,804**	**78,012**	**330**	**-**	**-**	**-**	**18,341**	**8,152**	**162,510**	**-3.4%**	**12.6%**
NY-AB (West)	4,473	14,856	1,479	-	-	-	-	4,657	1,862	27,327	10.6%	-0.3%
NY-CDE (Cent North)	20,397	9,481	7,356	330	-	-	-	12,806	2,129	52,499	15.0%	16.7%
NY-F (Capital)	-	2,455	9,037	-	-	-	-	215	1,238	12,945	5.6%	-33.7%
NY-GHI (Southeast)	-	318	16,331	-	-	-	-	-	1,002	17,652	-46.1%	5.2%
NY-J (NY City)	-	5,694	27,761	-	-	-	-	55	634	34,144	-2.4%	42.7%
NY-K (Long Island)	-	-	16,049	-	-	-	-	608	1,285	17,942	0.3%	53.4%

GWh											% Change from Sc. 1	% Change from 2015 this Scenario
Scenario 31 - IPEC 2 Seq. Years base	Nuclear	Hydro&PS	NatGas	Coal	Oil 6	Oil 2	Ker	Wind	Other (Wood, Refuse, Bio, PV, DR/LaaR)	Total		
2015 Total All Zones	**39,975**	**27,273**	**67,425**	**5,376**	**-**	**6**	**1**	**5,865**	**3,146**	**149,066**	**0.0%**	**0.0%**
NY-AB (West)	4,151	14,891	1,928	4,924	-	-	-	1,072	828	27,793	0.0%	0.0%
NY-CDE (Cent North)	20,408	9,481	9,427	452	-	-	-	4,737	818	45,322	0.0%	0.0%
NY-F (Capital)	-	2,583	17,839	-	-	-	-	55	153	20,630	0.0%	0.0%
NY-GHI (Southeast)	15,417	318	746	-	-	-	-	-	535	17,016	0.0%	0.0%
NY-J (NY City)	-	-	25,909	-	-	-	-	-	54	25,964	0.0%	0.0%
NY-K (Long Island)	-	-	11,576	-	-	6	1	-	758	12,342	0.0%	0.0%
2016 Total All Zones	**37,299**	**27,303**	**72,705**	**5,019**	**6**	**25**	**4**	**5,884**	**3,317**	**151,562**	**-0.5%**	**1.7%**
NY-AB (West)	4,487	14,897	1,916	4,578	-	-	-	1,077	832	27,787	0.3%	0.0%
NY-CDE (Cent North)	19,587	9,481	9,344	442	6	-	-	4,752	823	44,434	0.3%	-2.0%
NY-F (Capital)	-	2,608	17,842	-	-	-	-	55	153	20,659	1.6%	0.1%
NY-GHI (Southeast)	13,224	318	4,652	-	-	0	-	-	545	18,740	-8.8%	10.1%
NY-J (NY City)	-	-	27,293	-	-	2	-	-	198	27,493	1.7%	5.9%
NY-K (Long Island)	-	-	11,658	-	-	23	4	-	765	12,450	0.7%	0.9%
2017 Total All Zones	**31,062**	**27,352**	**76,578**	**4,912**	**24**	**16**	**2**	**6,121**	**3,298**	**149,364**	**-2.0%**	**0.2%**
NY-AB (West)	4,113	14,894	1,958	4,468	-	-	-	1,071	833	27,337	1.9%	-1.6%
NY-CDE (Cent North)	20,407	9,481	9,446	444	24	-	-	4,994	823	45,618	1.4%	0.7%
NY-F (Capital)	-	2,659	18,165	-	-	-	-	55	153	21,032	9.5%	1.9%
NY-GHI (Southeast)	6,543	318	6,603	-	-	0	-	-	541	14,006	-36.7%	-17.7%
NY-J (NY City)	-	-	28,913	-	-	1	-	-	188	29,102	6.4%	12.1%
NY-K (Long Island)	-	-	11,493	-	-	15	2	-	759	12,270	3.1%	-0.6%
2018 Total All Zones	**31,110**	**32,847**	**75,703**	**3,758**	**-**	**3**	**1**	**6,123**	**3,256**	**152,800**	**-1.2%**	**2.5%**
NY-AB (West)	4,149	14,870	1,679	3,346	-	-	-	1,071	824	25,940	2.6%	-6.7%
NY-CDE (Cent North)	19,531	9,481	8,455	412	-	-	-	4,996	823	43,698	0.9%	-3.6%
NY-F (Capital)	-	2,483	14,384	-	-	-	-	55	153	17,075	12.1%	-17.2%
NY-GHI (Southeast)	7,429	318	13,851	-	-	-	-	-	534	22,132	-23.2%	30.1%
NY-J (NY City)	-	5,694	26,636	-	-	-	-	-	169	32,499	5.6%	25.2%
NY-K (Long Island)	-	-	10,698	-	-	3	1	-	753	11,456	1.5%	-7.2%
2019 Total All Zones	**39,672**	**32,863**	**70,085**	**3,235**	**-**	**4**	**1**	**6,128**	**3,254**	**155,242**	**-0.1%**	**4.1%**
NY-AB (West)	4,474	14,878	1,606	2,834	-	-	-	1,072	827	25,691	0.0%	-7.6%
NY-CDE (Cent North)	20,399	9,481	8,140	401	-	-	-	5,001	825	44,246	0.0%	-2.4%
NY-F (Capital)	-	2,492	12,126	-	-	-	-	55	153	14,827	0.7%	-28.1%
NY-GHI (Southeast)	14,799	318	12,715	-	-	-	-	-	532	28,365	-1.4%	66.7%
NY-J (NY City)	-	5,694	24,860	-	-	-	-	-	166	30,720	0.3%	18.3%
NY-K (Long Island)	-	-	10,637	-	-	4	1	-	751	11,393	0.2%	-7.7%
2020 Total All Zones	**38,523**	**32,885**	**73,529**	**2,223**	**-**	**3**	**1**	**6,458**	**3,254**	**156,876**	**-0.1%**	**5.2%**
NY-AB (West)	4,126	14,882	1,589	1,866	-	-	-	1,077	821	24,361	0.0%	-12.3%
NY-CDE (Cent North)	19,586	9,481	8,012	357	-	-	-	5,326	826	43,588	0.0%	-3.8%
NY-F (Capital)	-	2,509	12,721	-	-	-	-	55	153	15,439	1.5%	-25.2%
NY-GHI (Southeast)	14,810	318	15,443	-	-	-	-	-	533	31,105	-1.6%	82.8%
NY-J (NY City)	-	5,694	25,237	-	-	-	-	-	165	31,096	0.3%	19.8%
NY-K (Long Island)	-	-	10,527	-	-	3	1	-	754	11,286	0.1%	-8.6%
2021 Total All Zones	**39,351**	**32,856**	**77,588**	**2,100**	**9**	**2**	**1**	**7,145**	**3,301**	**162,353**	**-0.1%**	**8.9%**
NY-AB (West)	4,151	14,875	1,574	1,755	-	-	-	1,315	822	24,492	0.0%	-11.9%
NY-CDE (Cent North)	20,405	9,481	7,859	345	9	-	-	5,775	855	44,729	0.0%	-1.3%
NY-F (Capital)	-	2,488	11,223	-	-	-	-	55	165	13,931	0.6%	-32.5%
NY-GHI (Southeast)	14,795	318	18,271	-	-	-	-	-	532	33,917	-1.0%	99.3%
NY-J (NY City)	-	5,694	26,230	-	-	-	-	-	170	32,094	0.3%	23.6%
NY-K (Long Island)	-	-	12,430	-	-	2	1	-	756	13,189	0.1%	6.9%
2022 Total All Zones	**38,767**	**32,860**	**78,631**	**1,684**	**-**	**2**	**1**	**7,675**	**3,302**	**162,922**	**-0.1%**	**9.3%**
NY-AB (West)	4,475	14,877	1,517	1,350	-	-	-	1,539	818	24,576	0.0%	-11.6%
NY-CDE (Cent North)	19,535	9,481	7,708	333	-	-	-	6,081	863	44,000	0.0%	-2.9%
NY-F (Capital)	-	2,490	11,066	-	-	-	-	55	165	13,777	1.0%	-33.2%
NY-GHI (Southeast)	14,757	318	18,095	-	-	-	-	-	532	33,702	-1.1%	98.1%
NY-J (NY City)	-	5,694	27,908	-	-	-	-	-	168	33,771	0.4%	30.1%
NY-K (Long Island)	-	-	12,338	-	-	2	1	-	755	13,096	0.1%	6.1%
2023 Total All Zones	**39,299**	**32,914**	**78,619**	**1,802**	**-**	**3**	**1**	**8,193**	**3,375**	**164,207**	**-0.1%**	**10.2%**
NY-AB (West)	4,114	14,884	1,507	1,464	-	-	-	1,536	819	24,325	0.0%	-12.5%
NY-CDE (Cent North)	20,396	9,481	7,623	338	-	-	-	6,602	934	45,374	0.0%	0.1%
NY-F (Capital)	-	2,536	11,073	-	-	-	-	55	165	13,830	1.2%	-33.0%
NY-GHI (Southeast)	14,789	318	18,124	-	-	-	-	-	532	33,764	-1.4%	98.4%
NY-J (NY City)	-	5,694	27,949	-	-	-	-	-	166	33,809	0.4%	30.2%
NY-K (Long Island)	-	-	12,342	-	-	3	1	-	759	13,105	0.1%	6.2%
2024 Total All Zones	**38,556**	**32,972**	**79,025**	**1,986**	**-**	**1**	**0**	**9,123**	**3,389**	**165,050**	**-0.1%**	**10.7%**
NY-AB (West)	4,162	14,887	1,508	1,639	-	-	-	1,544	819	24,559	0.0%	-11.6%
NY-CDE (Cent North)	19,590	9,481	7,608	347	-	-	-	6,915	947	44,888	0.0%	-1.0%
NY-F (Capital)	-	2,592	10,489	-	-	-	-	55	166	13,302	0.3%	-35.5%
NY-GHI (Southeast)	14,803	318	17,609	-	-	-	-	-	533	33,264	-1.4%	95.5%
NY-J (NY City)	-	5,694	27,439	-	-	-	-	-	165	33,299	0.5%	28.3%
NY-K (Long Island)	-	-	14,371	-	-	1	0	609	759	15,739	0.1%	27.5%
2025 Total All Zones	**39,618**	**32,984**	**80,930**	**1,824**	**-**	**0**	**-**	**9,158**	**3,524**	**168,038**	**-0.1%**	**12.7%**
NY-AB (West)	4,473	14,896	1,495	1,485	-	-	-	1,539	810	24,698	0.0%	-11.1%
NY-CDE (Cent North)	20,397	9,481	7,442	340	-	-	-	6,900	1,085	45,644	0.0%	0.7%
NY-F (Capital)	-	2,595	9,497	-	-	-	-	55	165	12,313	0.4%	-40.3%
NY-GHI (Southeast)	14,747	318	16,679	-	-	-	-	-	532	32,277	-1.4%	89.7%
NY-J (NY City)	-	5,694	29,247	-	-	-	-	55	165	35,161	0.5%	35.4%
NY-K (Long Island)	-	-	16,570	-	-	0	-	608	767	17,945	0.3%	45.4%

GWh	% Change from Sc. 1	% Change from 2015 this Scenario

GWh												% Change from Sc. 1	% Change from 2015 this Scenario
Scenario 34 - IPEC 2 Seq. Years HI EE, Wind, PV	Nuclear	Hydro&PS	NatGas	Coal	Oil 6	Oil 2	Ker	Wind	Other (Wood, Refuse, Bio, PV, DR/LaaR)	Total			
2015 Total All Zones	**39,975**	**27,317**	**62,171**	**4,913**	**-**	**4**	**0**	**5,865**	**4,035**	**144,281**		**-3.2%**	**0.0%**
NY-AB (West)	4,151	14,895	1,787	4,485	-	-	-	1,072	1,008	27,397		-1.4%	0.0%
NY-CDE (Cent North)	20,408	9,481	8,924	428	-	-	-	4,737	1,001	44,978		-0.8%	0.0%
NY-F (Capital)	-	2,624	16,488	-	-	-	-	55	348	19,515		-5.4%	0.0%
NY-GHI (Southeast)	15,417	318	415	-	-	-	-	-	627	16,776		-1.4%	0.0%
NY-J (NY City)	-	-	23,784	-	-	-	-	-	137	23,921		-7.9%	0.0%
NY-K (Long Island)	-	-	10,774	-	-	4	0	-	914	11,693		-5.3%	0.0%
2016 Total All Zones	**37,299**	**27,298**	**69,163**	**472**	**-**	**18**	**3**	**5,884**	**4,687**	**144,825**		**-4.9%**	**0.4%**
NY-AB (West)	4,487	14,899	1,953	45	-	-	-	1,077	1,129	23,591		-14.8%	-13.9%
NY-CDE (Cent North)	19,587	9,481	9,228	427	-	-	-	4,752	1,121	44,596		0.7%	-0.9%
NY-F (Capital)	-	2,600	16,947	-	-	-	-	55	460	20,062		-1.4%	2.8%
NY-GHI (Southeast)	13,224	318	4,355	-	-	0	-	-	684	18,582		-9.6%	10.8%
NY-J (NY City)	-	-	25,696	-	-	1	-	-	323	26,020		-3.7%	8.8%
NY-K (Long Island)	-	-	10,984	-	-	17	3	-	970	11,974		-3.2%	2.4%
2017 Total All Zones	**31,062**	**27,307**	**72,465**	**472**	**3**	**8**	**1**	**6,121**	**5,153**	**142,594**		**-6.5%**	**-1.2%**
NY-AB (West)	4,113	14,894	1,947	42	-	-	-	1,071	1,243	23,309		-13.1%	-14.9%
NY-CDE (Cent North)	20,407	9,481	9,260	430	3	-	-	4,994	1,234	45,809		1.8%	1.8%
NY-F (Capital)	-	2,615	17,031	-	-	-	-	55	569	20,270		5.5%	3.9%
NY-GHI (Southeast)	6,543	318	6,217	-	-	0	-	-	725	13,804		-37.6%	-17.7%
NY-J (NY City)	-	-	27,179	-	-	0	-	-	368	27,547		0.7%	15.2%
NY-K (Long Island)	-	-	10,831	-	-	8	1	-	1,015	11,854		-0.4%	1.4%
2018 Total All Zones	**31,110**	**32,775**	**69,285**	**415**	**-**	**3**	**0**	**7,265**	**5,572**	**146,425**		**-5.3%**	**1.5%**
NY-AB (West)	4,149	14,864	1,665	19	-	-	-	1,459	1,337	23,493		-7.1%	-14.2%
NY-CDE (Cent North)	19,531	9,481	8,156	396	-	-	-	5,731	1,336	44,631		3.1%	-0.8%
NY-F (Capital)	-	2,418	12,442	-	-	-	-	75	678	15,613		2.5%	-20.0%
NY-GHI (Southeast)	7,429	318	12,971	-	-	-	-	-	768	21,486		-25.4%	28.1%
NY-J (NY City)	-	5,694	24,100	-	-	-	-	-	400	30,194		-1.9%	26.2%
NY-K (Long Island)	-	-	9,951	-	-	3	0	-	1,054	11,008		-2.5%	-5.9%
2019 Total All Zones	**39,672**	**32,760**	**62,610**	**398**	**-**	**1**	**-**	**8,419**	**6,043**	**149,903**		**-3.6%**	**3.9%**
NY-AB (West)	4,474	14,866	1,579	13	-	-	-	1,850	1,449	24,231		-5.7%	-11.6%
NY-CDE (Cent North)	20,399	9,481	7,790	385	-	-	-	6,475	1,451	45,980		4.0%	2.2%
NY-F (Capital)	-	2,401	10,035	-	-	-	-	95	786	13,316		-9.6%	-31.8%
NY-GHI (Southeast)	14,799	318	11,383	-	-	-	-	-	814	27,314		-5.1%	62.8%
NY-J (NY City)	-	5,694	22,054	-	-	-	-	-	446	28,195		-8.0%	17.9%
NY-K (Long Island)	-	-	9,769	-	-	1	-	-	1,097	10,867		-4.5%	-7.1%
2020 Total All Zones	**38,523**	**32,726**	**64,504**	**334**	**-**	**1**	**-**	**9,907**	**6,519**	**152,514**		**-2.9%**	**5.7%**
NY-AB (West)	4,126	14,855	1,536	-	-	-	-	2,248	1,553	24,317		-0.2%	-11.2%
NY-CDE (Cent North)	19,586	9,481	7,602	334	-	-	-	7,544	1,564	46,112		5.8%	2.5%
NY-F (Capital)	-	2,378	9,711	-	-	-	-	115	898	13,102		-13.9%	-32.9%
NY-GHI (Southeast)	14,810	318	13,695	-	-	-	-	-	862	29,686		-6.1%	76.9%
NY-J (NY City)	-	5,694	22,258	-	-	-	-	-	494	28,446		-8.2%	18.9%
NY-K (Long Island)	-	-	9,703	-	-	1	-	-	1,148	10,851		-3.8%	-7.2%
2021 Total All Zones	**39,351**	**32,730**	**67,952**	**327**	**-**	**1**	**0**	**11,740**	**7,033**	**159,134**		**-2.1%**	**10.3%**
NY-AB (West)	4,151	14,854	1,512	-	-	-	-	2,875	1,663	25,054		2.3%	-8.6%
NY-CDE (Cent North)	20,405	9,481	7,440	327	-	-	-	8,730	1,702	48,084		7.5%	6.9%
NY-F (Capital)	-	2,383	8,812	-	-	-	-	135	1,021	12,351		-10.8%	-36.7%
NY-GHI (Southeast)	14,795	318	15,699	-	-	-	-	-	908	31,721		-7.4%	89.1%
NY-J (NY City)	-	5,694	22,959	-	-	-	-	-	543	29,196		-8.8%	22.0%
NY-K (Long Island)	-	-	11,530	-	-	1	0	-	1,196	12,728		-3.4%	8.9%
2022 Total All Zones	**38,770**	**32,749**	**67,471**	**307**	**-**	**1**	**-**	**13,415**	**7,500**	**160,214**		**-1.7%**	**11.0%**
NY-AB (West)	4,475	14,853	1,463	-	-	-	-	3,488	1,766	26,045		6.0%	-4.9%
NY-CDE (Cent North)	19,537	9,481	7,232	307	-	-	-	9,773	1,817	48,147		9.4%	7.0%
NY-F (Capital)	-	2,402	8,087	-	-	-	-	155	1,131	11,775		-13.7%	-39.7%
NY-GHI (Southeast)	14,757	318	14,998	-	-	-	-	-	955	31,029		-8.9%	85.0%
NY-J (NY City)	-	5,694	24,242	-	-	-	-	-	589	30,526		-9.3%	27.6%
NY-K (Long Island)	-	-	11,449	-	-	1	-	-	1,241	12,691		-3.0%	8.5%
2023 Total All Zones	**39,299**	**32,785**	**66,745**	**311**	**-**	**1**	**0**	**15,050**	**8,029**	**162,221**		**-1.3%**	**12.4%**
NY-AB (West)	4,114	14,859	1,453	-	-	-	-	3,864	1,870	26,161		7.6%	-4.5%
NY-CDE (Cent North)	20,396	9,481	7,128	311	-	-	-	11,012	1,994	50,321		10.9%	11.9%
NY-F (Capital)	-	2,432	7,781	-	-	-	-	174	1,240	11,627		-14.9%	-40.4%
NY-GHI (Southeast)	14,789	318	15,024	-	-	-	-	-	1,002	31,133		-9.1%	85.6%
NY-J (NY City)	-	5,694	23,945	-	-	-	-	-	636	30,275		-10.1%	26.6%
NY-K (Long Island)	-	-	11,414	-	-	1	0	-	1,288	12,703		-2.9%	8.6%
2024 Total All Zones	**38,556**	**32,810**	**66,519**	**317**	**-**	**-**	**-**	**17,165**	**8,014**	**163,381**		**-1.1%**	**13.2%**
NY-AB (West)	4,162	14,858	1,451	-	-	-	-	4,275	1,859	26,605		8.3%	-2.9%
NY-CDE (Cent North)	19,590	9,481	7,045	317	-	-	-	12,086	1,996	50,515		12.6%	12.3%
NY-F (Capital)	-	2,459	7,774	-	-	-	-	195	1,237	11,665		-12.0%	-40.2%
NY-GHI (Southeast)	14,803	318	14,150	-	-	-	-	-	1,001	30,273		-10.2%	80.4%
NY-J (NY City)	-	5,694	22,823	-	-	-	-	-	635	29,151		-12.0%	21.9%
NY-K (Long Island)	-	-	13,275	-	-	-	-	609	1,287	15,171		-3.5%	29.7%
2025 Total All Zones	**39,617**	**32,804**	**67,658**	**307**	**-**	**-**	**-**	**18,339**	**8,124**	**166,850**		**-0.8%**	**15.6%**
NY-AB (West)	4,473	14,856	1,433	-	-	-	-	4,658	1,851	27,270		10.4%	-0.5%
NY-CDE (Cent North)	20,397	9,481	6,959	307	-	-	-	12,803	2,116	52,063		14.1%	15.8%
NY-F (Capital)	-	2,455	6,913	-	-	-	-	215	1,237	10,821		-11.7%	-44.6%
NY-GHI (Southeast)	14,747	318	12,862	-	-	-	-	-	999	28,927		-11.7%	72.4%
NY-J (NY City)	-	5,694	24,094	-	-	-	-	55	634	30,478		-12.9%	27.4%
NY-K (Long Island)	-	-	15,396	-	-	-	-	608	1,285	17,290		-3.4%	47.9%

NOx, metric Ktons												% Change from Sc. 1	% Change from 2015 this Scenario
Scenario 1 - IPEC in base EE, Wind, PV	Nuclear	Hydro&PS	NatGas	Coal	Oil 6	Oil 2	Ker	Wind	Other (Wood, Refuse, Bio, PV, DR/LaaR)	Total			
2015 Total All Zones	-	-	9.46	6.14	-	-	-	-	3.09	18.69		0.0%	0.0%
NY-AB (West)	-	-	0.73	5.41	-	-	-	-	0.55	6.68		0.0%	0.0%
NY-CDE (Cent North)	-	-	1.02	0.73	-	-	-	-	0.72	2.46		0.0%	0.0%
NY-F (Capital)	-	-	0.80	-	-	-	-	-	0.11	0.91		0.0%	0.0%
NY-GHI (Southeast)	-	-	0.37	-	-	-	-	-	0.64	1.01		0.0%	0.0%
NY-J (NY City)	-	-	2.60	-	-	-	-	-	-	2.60		0.0%	0.0%
NY-K (Long Island)	-	-	3.95	-	-	-	-	-	1.08	5.03		0.0%	0.0%
2016 Total All Zones	-	-	9.29	5.66	-	-	-	-	3.11	18.06		0.0%	-3.4%
NY-AB (West)	-	-	0.72	4.95	-	-	-	-	0.55	6.22		0.0%	-6.9%
NY-CDE (Cent North)	-	-	0.99	0.72	-	-	-	-	0.72	2.43		0.0%	-1.5%
NY-F (Capital)	-	-	0.78	-	-	-	-	-	0.11	0.89		0.0%	-2.0%
NY-GHI (Southeast)	-	-	0.38	-	-	-	-	-	0.65	1.03		0.0%	1.8%
NY-J (NY City)	-	-	2.41	-	-	-	-	-	-	2.41		0.0%	-7.3%
NY-K (Long Island)	-	-	4.01	-	-	-	-	-	1.08	5.09		0.0%	1.3%
2017 Total All Zones	-	-	8.67	5.25	-	-	-	-	3.09	17.01		0.0%	-9.0%
NY-AB (West)	-	-	0.68	4.54	-	-	-	-	0.55	5.76		0.0%	-13.7%
NY-CDE (Cent North)	-	-	0.95	0.71	-	-	-	-	0.72	2.38		0.0%	-3.3%
NY-F (Capital)	-	-	0.73	-	-	-	-	-	0.11	0.84		0.0%	-8.0%
NY-GHI (Southeast)	-	-	0.41	-	-	-	-	-	0.64	1.05		0.0%	3.6%
NY-J (NY City)	-	-	2.05	-	-	-	-	-	-	2.05		0.0%	-21.3%
NY-K (Long Island)	-	-	3.85	-	-	-	-	-	1.08	4.94		0.0%	-1.8%
2018 Total All Zones	-	-	7.48	3.71	-	-	-	-	3.09	14.28		0.0%	-23.6%
NY-AB (West)	-	-	0.62	3.04	-	-	-	-	0.55	4.20		0.0%	-37.1%
NY-CDE (Cent North)	-	-	0.85	0.67	-	-	-	-	0.72	2.25		0.0%	-8.9%
NY-F (Capital)	-	-	0.60	-	-	-	-	-	0.11	0.71		0.0%	-22.0%
NY-GHI (Southeast)	-	-	0.43	-	-	-	-	-	0.64	1.06		0.0%	5.4%
NY-J (NY City)	-	-	1.42	-	-	-	-	-	-	1.42		0.0%	-45.5%
NY-K (Long Island)	-	-	3.56	-	-	-	-	-	1.08	4.65		0.0%	-7.6%
2019 Total All Zones	-	-	7.64	3.79	-	-	-	-	3.09	14.52		0.0%	-22.3%
NY-AB (West)	-	-	0.63	3.12	-	-	-	-	0.55	4.29		0.0%	-35.8%
NY-CDE (Cent North)	-	-	0.85	0.67	-	-	-	-	0.72	2.25		0.0%	-8.9%
NY-F (Capital)	-	-	0.62	-	-	-	-	-	0.11	0.73		0.0%	-20.0%
NY-GHI (Southeast)	-	-	0.48	-	-	-	-	-	0.64	1.12		0.0%	10.8%
NY-J (NY City)	-	-	1.43	-	-	-	-	-	-	1.43		0.0%	-45.1%
NY-K (Long Island)	-	-	3.63	-	-	-	-	-	1.08	4.71		0.0%	-6.3%
2020 Total All Zones	-	-	7.57	2.73	-	-	-	-	3.11	13.41		0.0%	-28.3%
NY-AB (West)	-	-	0.62	2.11	-	-	-	-	0.55	3.28		0.0%	-50.9%
NY-CDE (Cent North)	-	-	0.84	0.62	-	-	-	-	0.72	2.17		0.0%	-11.8%
NY-F (Capital)	-	-	0.62	-	-	-	-	-	0.11	0.73		0.0%	-20.0%
NY-GHI (Southeast)	-	-	0.51	-	-	-	-	-	0.65	1.15		0.0%	14.4%
NY-J (NY City)	-	-	1.43	-	-	-	-	-	-	1.43		0.0%	-45.1%
NY-K (Long Island)	-	-	3.56	-	-	-	-	-	1.08	4.65		0.0%	-7.6%
2021 Total All Zones	-	-	7.21	2.57	0.02	-	-	-	3.09	12.89		0.0%	-31.0%
NY-AB (West)	-	-	0.61	1.97	-	-	-	-	0.55	3.13		0.0%	-53.2%
NY-CDE (Cent North)	-	-	0.83	0.60	0.02	-	-	-	0.72	2.16		0.0%	-12.2%
NY-F (Capital)	-	-	0.58	-	-	-	-	-	0.11	0.69		0.0%	-24.0%
NY-GHI (Southeast)	-	-	0.58	-	-	-	-	-	0.64	1.22		0.0%	20.7%
NY-J (NY City)	-	-	1.33	-	-	-	-	-	-	1.33		0.0%	-49.0%
NY-K (Long Island)	-	-	3.28	-	-	-	-	-	1.08	4.36		0.0%	-13.2%
2022 Total All Zones	-	-	7.09	2.09	-	-	-	-	3.09	12.27		0.0%	-34.3%
NY-AB (West)	-	-	0.59	1.51	-	-	-	-	0.55	2.65		0.0%	-60.4%
NY-CDE (Cent North)	-	-	0.79	0.58	-	-	-	-	0.72	2.09		0.0%	-15.1%
NY-F (Capital)	-	-	0.57	-	-	-	-	-	0.11	0.68		0.0%	-25.0%
NY-GHI (Southeast)	-	-	0.55	-	-	-	-	-	0.64	1.18		0.0%	17.1%
NY-J (NY City)	-	-	1.35	-	-	-	-	-	-	1.35		0.0%	-48.3%
NY-K (Long Island)	-	-	3.25	-	-	-	-	-	1.08	4.33		0.0%	-13.9%
2023 Total All Zones	-	-	7.11	2.24	-	-	-	-	3.09	12.44		0.0%	-33.5%
NY-AB (West)	-	-	0.58	1.65	-	-	-	-	0.55	2.77		0.0%	-58.5%
NY-CDE (Cent North)	-	-	0.78	0.59	-	-	-	-	0.72	2.09		0.0%	-15.1%
NY-F (Capital)	-	-	0.56	-	-	-	-	-	0.11	0.67		0.0%	-26.0%
NY-GHI (Southeast)	-	-	0.56	-	-	-	-	-	0.64	1.20		0.0%	18.9%
NY-J (NY City)	-	-	1.36	-	-	-	-	-	-	1.36		0.0%	-47.6%
NY-K (Long Island)	-	-	3.25	-	-	-	-	-	1.08	4.34		0.0%	-13.7%
2024 Total All Zones	-	-	6.86	2.46	-	-	-	-	3.11	12.44		0.0%	-33.5%
NY-AB (West)	-	-	0.58	1.86	-	-	-	-	0.55	3.00		0.0%	-55.1%
NY-CDE (Cent North)	-	-	0.77	0.60	-	-	-	-	0.72	2.09		0.0%	-15.1%
NY-F (Capital)	-	-	0.56	-	-	-	-	-	0.11	0.67		0.0%	-26.0%
NY-GHI (Southeast)	-	-	0.54	-	-	-	-	-	0.65	1.18		0.0%	17.1%
NY-J (NY City)	-	-	1.35	-	-	-	-	-	-	1.35		0.0%	-48.3%
NY-K (Long Island)	-	-	3.06	-	-	-	-	-	1.08	4.15		0.0%	-17.5%
2025 Total All Zones	-	-	6.61	2.28	-	-	-	-	3.10	11.99		0.0%	-35.8%
NY-AB (West)	-	-	0.58	1.69	-	-	-	-	0.55	2.82		0.0%	-57.8%
NY-CDE (Cent North)	-	-	0.75	0.59	-	-	-	-	0.73	2.07		0.0%	-15.9%
NY-F (Capital)	-	-	0.54	-	-	-	-	-	0.11	0.65		0.0%	-29.0%
NY-GHI (Southeast)	-	-	0.54	-	-	-	-	-	0.64	1.17		0.0%	16.2%
NY-J (NY City)	-	-	1.25	-	-	-	-	-	-	1.25		0.0%	-51.7%
NY-K (Long Island)	-	-	2.95	-	-	-	-	-	1.08	4.03		0.0%	-19.9%

NOx, metric Ktons												% Change from Sc. 1	% Change from 2015 this Scenario
Scenario 11 - IPEC OOS		Nuclear	Hydro&PS	NatGas	Coal	Oil 6	Oil 2	Ker	Wind	Other (Wood, Refuse, Bio, PV, DR/LaaR)	Total		
		-	-	-	-	-	-	-	-	-	-		
	2015 Total All Zones	-	-	9.46	6.14	-	-	-	-	3.09	18.69	0.0%	0.0%
NY-AB (West)		-	-	0.73	5.41	-	-	-	-	0.55	6.68	0.0%	0.0%
NY-CDE (Cent North)		-	-	1.02	0.73	-	-	-	-	0.72	2.46	0.0%	0.0%
NY-F (Capital)		-	-	0.80	-	-	-	-	-	0.11	0.91	0.0%	0.0%
NY-GHI (Southeast)		-	-	0.37	-	-	-	-	-	0.64	1.01	0.0%	0.0%
NY-J (NY City)		-	-	2.60	-	-	-	-	-	-	2.60	0.0%	0.0%
NY-K (Long Island)		-	-	3.95	-	-	-	-	-	1.08	5.03	0.0%	0.0%
	2016 Total All Zones	-	-	11.47	6.64	0.02	0.01	-	-	3.11	21.25	17.6%	13.7%
NY-AB (West)		-	-	0.82	5.88	-	-	-	-	0.55	7.25	16.7%	8.6%
NY-CDE (Cent North)		-	-	1.15	0.75	0.02	-	-	-	0.72	2.65	9.0%	7.4%
NY-F (Capital)		-	-	0.88	-	-	-	-	-	0.11	0.99	11.2%	9.0%
NY-GHI (Southeast)		-	-	0.77	-	-	-	-	-	0.65	1.42	38.1%	40.5%
NY-J (NY City)		-	-	3.57	-	-	-	-	-	-	3.57	48.3%	37.4%
NY-K (Long Island)		-	-	4.27	-	-	0.01	-	-	1.08	5.36	5.4%	6.7%
	2017 Total All Zones	-	-	10.43	6.20	0.04	-	-	-	3.09	19.75	16.1%	5.7%
NY-AB (West)		-	-	0.78	5.45	-	-	-	-	0.55	6.78	17.7%	1.5%
NY-CDE (Cent North)		-	-	1.08	0.75	0.04	-	-	-	0.72	2.58	8.4%	4.8%
NY-F (Capital)		-	-	0.85	-	-	-	-	-	0.11	0.96	15.2%	6.0%
NY-GHI (Southeast)		-	-	0.74	-	-	-	-	-	0.64	1.37	31.3%	36.0%
NY-J (NY City)		-	-	2.93	-	-	-	-	-	-	2.93	43.1%	12.6%
NY-K (Long Island)		-	-	4.05	-	-	-	-	-	1.08	5.13	3.9%	2.0%
	2018 Total All Zones	-	-	8.48	4.77	-	-	-	-	3.09	16.35	14.4%	-12.5%
NY-AB (West)		-	-	0.67	4.07	-	-	-	-	0.55	5.29	26.0%	-20.8%
NY-CDE (Cent North)		-	-	0.94	0.70	-	-	-	-	0.72	2.35	4.9%	-4.4%
NY-F (Capital)		-	-	0.73	-	-	-	-	-	0.11	0.84	17.9%	-8.0%
NY-GHI (Southeast)		-	-	0.62	-	-	-	-	-	0.64	1.25	17.9%	24.3%
NY-J (NY City)		-	-	1.85	-	-	-	-	-	-	1.85	30.8%	-28.7%
NY-K (Long Island)		-	-	3.67	-	-	-	-	-	1.08	4.75	2.3%	-5.4%
	2019 Total All Zones	-	-	8.61	4.79	-	-	-	-	3.09	16.49	13.6%	-11.8%
NY-AB (West)		-	-	0.67	4.08	-	-	-	-	0.55	5.30	23.5%	-20.7%
NY-CDE (Cent North)		-	-	0.94	0.71	-	-	-	-	0.72	2.36	5.3%	-4.1%
NY-F (Capital)		-	-	0.74	-	-	-	-	-	0.11	0.85	16.3%	-7.0%
NY-GHI (Southeast)		-	-	0.66	-	-	-	-	-	0.64	1.30	16.3%	28.8%
NY-J (NY City)		-	-	1.83	-	-	-	-	-	-	1.83	28.0%	-29.7%
NY-K (Long Island)		-	-	3.77	-	-	-	-	-	1.08	4.85	3.1%	-3.4%
	2020 Total All Zones	-	-	8.50	3.59	-	-	-	-	3.11	15.20	13.4%	-18.7%
NY-AB (West)		-	-	0.66	2.93	-	-	-	-	0.55	4.15	26.3%	-38.0%
NY-CDE (Cent North)		-	-	0.93	0.66	-	-	-	-	0.72	2.31	6.3%	-6.3%
NY-F (Capital)		-	-	0.74	-	-	-	-	-	0.11	0.85	16.3%	-7.0%
NY-GHI (Southeast)		-	-	0.71	-	-	-	-	-	0.65	1.35	17.3%	34.2%
NY-J (NY City)		-	-	1.78	-	-	-	-	-	-	1.78	24.8%	-31.5%
NY-K (Long Island)		-	-	3.68	-	-	-	-	-	1.08	4.76	2.5%	-5.2%
	2021 Total All Zones	-	-	7.97	3.36	0.02	-	-	-	3.09	14.45	12.1%	-22.7%
NY-AB (West)		-	-	0.64	2.73	-	-	-	-	0.55	3.91	25.0%	-41.5%
NY-CDE (Cent North)		-	-	0.90	0.64	0.02	-	-	-	0.72	2.27	5.0%	-7.7%
NY-F (Capital)		-	-	0.70	-	-	-	-	-	0.11	0.81	17.1%	-11.0%
NY-GHI (Southeast)		-	-	0.73	-	-	-	-	-	0.64	1.36	11.9%	35.1%
NY-J (NY City)		-	-	1.65	-	-	-	-	-	-	1.65	24.0%	-36.7%
NY-K (Long Island)		-	-	3.36	-	-	-	-	-	1.08	4.45	1.9%	-11.6%
	2022 Total All Zones	-	-	7.84	2.90	-	-	-	-	3.09	13.83	12.7%	-26.0%
NY-AB (West)		-	-	0.62	2.28	-	-	-	-	0.55	3.45	30.2%	-48.4%
NY-CDE (Cent North)		-	-	0.86	0.62	-	-	-	-	0.72	2.20	5.2%	-10.7%
NY-F (Capital)		-	-	0.68	-	-	-	-	-	0.11	0.79	16.0%	-13.0%
NY-GHI (Southeast)		-	-	0.72	-	-	-	-	-	0.64	1.35	14.6%	34.2%
NY-J (NY City)		-	-	1.64	-	-	-	-	-	-	1.64	21.6%	-37.1%
NY-K (Long Island)		-	-	3.32	-	-	-	-	-	1.08	4.40	1.7%	-12.5%
	2023 Total All Zones	-	-	7.79	3.20	-	-	-	-	3.09	14.08	13.2%	-24.7%
NY-AB (West)		-	-	0.61	2.57	-	-	-	-	0.55	3.73	34.4%	-44.2%
NY-CDE (Cent North)		-	-	0.86	0.63	-	-	-	-	0.72	2.21	5.7%	-10.3%
NY-F (Capital)		-	-	0.67	-	-	-	-	-	0.11	0.78	16.2%	-14.0%
NY-GHI (Southeast)		-	-	0.69	-	-	-	-	-	0.64	1.33	10.6%	31.5%
NY-J (NY City)		-	-	1.62	-	-	-	-	-	-	1.62	18.7%	-37.8%
NY-K (Long Island)		-	-	3.34	-	-	-	-	-	1.08	4.42	1.9%	-12.1%
	2024 Total All Zones	-	-	7.58	3.36	-	-	-	-	3.11	14.05	13.0%	-24.8%
NY-AB (West)		-	-	0.61	2.74	-	-	-	-	0.55	3.90	30.0%	-41.6%
NY-CDE (Cent North)		-	-	0.85	0.63	-	-	-	-	0.72	2.19	4.8%	-11.1%
NY-F (Capital)		-	-	0.67	-	-	-	-	-	0.11	0.78	16.2%	-14.0%
NY-GHI (Southeast)		-	-	0.71	-	-	-	-	-	0.65	1.35	14.6%	34.2%
NY-J (NY City)		-	-	1.60	-	-	-	-	-	-	1.60	18.9%	-38.5%
NY-K (Long Island)		-	-	3.15	-	-	-	-	-	1.08	4.23	2.0%	-15.9%
	2025 Total All Zones	-	-	7.37	2.86	0.01	-	-	-	3.10	13.35	11.3%	-28.6%
NY-AB (West)		-	-	0.61	2.25	-	-	-	-	0.55	3.40	20.6%	-49.1%
NY-CDE (Cent North)		-	-	0.85	0.62	0.01	-	-	-	0.73	2.20	6.1%	-10.7%
NY-F (Capital)		-	-	0.62	-	-	-	-	-	0.11	0.73	12.7%	-20.0%
NY-GHI (Southeast)		-	-	0.72	-	-	-	-	-	0.64	1.35	15.5%	34.2%
NY-J (NY City)		-	-	1.53	-	-	-	-	-	-	1.53	21.7%	-41.3%
NY-K (Long Island)		-	-	3.05	-	-	-	-	-	1.08	4.14	2.7%	-17.7%

NOx, metric Ktons												% Change from Sc. 1	% Change from 2015 this Scenario
Scenario 14 - IPEC OOS Hi EE, Wind, PV		Nuclear	Hydro&PS	NatGas	Coal	Oil 6	Oil 2	Ker	Wind	Other (Wood, Refuse, Bio, PV, DR/LaaR)	Total		
		-	-	-	-	-	-	-	-	-	-		
	2015 Total All Zones	-	-	8.29	5.66	-	-	-	-	3.09	17.05	-8.8%	0.0%
NY-AB (West)		-	-	0.67	4.95	-	-	-	-	0.55	6.17	-7.6%	0.0%
NY-CDE (Cent North)		-	-	0.95	0.71	-	-	-	-	0.72	2.38	-3.3%	0.0%
NY-F (Capital)		-	-	0.75	-	-	-	-	-	0.11	0.85	-6.0%	0.0%
NY-GHI (Southeast)		-	-	0.18	-	-	-	-	-	0.64	0.82	-18.9%	0.0%
NY-J (NY City)		-	-	2.06	-	-	-	-	-	-	2.06	-20.6%	0.0%
NY-K (Long Island)		-	-	3.67	-	-	-	-	-	1.08	4.75	-5.4%	0.0%
	2016 Total All Zones	-	-	10.71	0.89	-	-	-	-	3.11	14.71	-18.6%	-13.7%
NY-AB (West)		-	-	0.85	0.15	-	-	-	-	0.55	1.56	-74.9%	-74.7%
NY-CDE (Cent North)		-	-	1.14	0.74	-	-	-	-	0.72	2.59	6.7%	8.8%
NY-F (Capital)		-	-	0.87	-	-	-	-	-	0.11	0.98	10.2%	14.9%
NY-GHI (Southeast)		-	-	0.68	-	-	-	-	-	0.65	1.33	29.2%	62.2%
NY-J (NY City)		-	-	3.09	-	-	-	-	-	-	3.09	28.3%	49.8%
NY-K (Long Island)		-	-	4.07	-	-	-	-	-	1.08	5.15	1.3%	8.4%
	2017 Total All Zones	-	-	9.57	0.85	-	-	-	-	3.09	13.51	-20.6%	-20.7%
NY-AB (West)		-	-	0.79	0.13	-	-	-	-	0.55	1.46	-74.6%	-76.3%
NY-CDE (Cent North)		-	-	1.06	0.72	-	-	-	-	0.72	2.50	5.0%	5.0%
NY-F (Capital)		-	-	0.82	-	-	-	-	-	0.11	0.93	10.9%	8.5%
NY-GHI (Southeast)		-	-	0.61	-	-	-	-	-	0.64	1.25	19.1%	52.2%
NY-J (NY City)		-	-	2.46	-	-	-	-	-	-	2.46	20.4%	19.4%
NY-K (Long Island)		-	-	3.83	-	-	-	-	-	1.08	4.91	-0.6%	3.3%
	2018 Total All Zones	-	-	7.83	0.75	-	-	-	-	3.09	11.66	-18.3%	-31.6%
NY-AB (West)		-	-	0.65	0.06	-	-	-	-	0.55	1.26	-69.9%	-79.5%
NY-CDE (Cent North)		-	-	0.90	0.68	-	-	-	-	0.72	2.30	2.4%	-3.4%
NY-F (Capital)		-	-	0.67	-	-	-	-	-	0.11	0.78	10.3%	-8.5%
NY-GHI (Southeast)		-	-	0.54	-	-	-	-	-	0.64	1.17	10.3%	43.3%
NY-J (NY City)		-	-	1.62	-	-	-	-	-	-	1.62	14.1%	-21.6%
NY-K (Long Island)		-	-	3.45	-	-	-	-	-	1.08	4.53	-2.5%	-4.8%
	2019 Total All Zones	-	-	7.77	0.75	-	-	-	-	3.09	11.61	-20.0%	-31.9%
NY-AB (West)		-	-	0.65	0.05	-	-	-	-	0.55	1.25	-70.8%	-79.7%
NY-CDE (Cent North)		-	-	0.92	0.69	-	-	-	-	0.72	2.33	3.6%	-2.3%
NY-F (Capital)		-	-	0.66	-	-	-	-	-	0.11	0.77	6.3%	-9.6%
NY-GHI (Southeast)		-	-	0.55	-	-	-	-	-	0.64	1.19	6.5%	45.6%
NY-J (NY City)		-	-	1.53	-	-	-	-	-	-	1.53	7.0%	-26.0%
NY-K (Long Island)		-	-	3.45	-	-	-	-	-	1.08	4.54	-3.7%	-4.6%
	2020 Total All Zones	-	-	7.55	0.64	-	-	-	-	3.11	11.30	-15.7%	-33.7%
NY-AB (West)		-	-	0.64	0.01	-	-	-	-	0.55	1.20	-63.4%	-80.6%
NY-CDE (Cent North)		-	-	0.87	0.63	-	-	-	-	0.72	2.22	2.1%	-6.9%
NY-F (Capital)		-	-	0.65	-	-	-	-	-	0.11	0.76	5.0%	-10.6%
NY-GHI (Southeast)		-	-	0.57	-	-	-	-	-	0.65	1.22	5.5%	48.9%
NY-J (NY City)		-	-	1.45	-	-	-	-	-	-	1.45	1.3%	-30.0%
NY-K (Long Island)		-	-	3.37	-	-	-	-	-	1.08	4.45	-4.1%	-6.3%
	2021 Total All Zones	-	-	7.17	0.61	-	-	-	-	3.09	10.87	-15.7%	-36.2%
NY-AB (West)		-	-	0.63	-	-	-	-	-	0.55	1.17	-62.5%	-81.0%
NY-CDE (Cent North)		-	-	0.85	0.61	-	-	-	-	0.72	2.18	0.8%	-8.4%
NY-F (Capital)		-	-	0.61	-	-	-	-	-	0.11	0.72	3.9%	-16.0%
NY-GHI (Southeast)		-	-	0.62	-	-	-	-	-	0.64	1.25	3.0%	53.3%
NY-J (NY City)		-	-	1.35	-	-	-	-	-	-	1.35	1.4%	-34.8%
NY-K (Long Island)		-	-	3.12	-	-	-	-	-	1.08	4.20	-3.7%	-11.7%
	2022 Total All Zones	-	-	6.99	0.58	-	-	-	-	3.09	10.66	-13.1%	-37.4%
NY-AB (West)		-	-	0.60	-	-	-	-	-	0.55	1.15	-56.7%	-81.4%
NY-CDE (Cent North)		-	-	0.82	0.58	-	-	-	-	0.72	2.12	1.3%	-11.1%
NY-F (Capital)		-	-	0.58	-	-	-	-	-	0.11	0.69	1.3%	-19.1%
NY-GHI (Southeast)		-	-	0.57	-	-	-	-	-	0.64	1.21	2.3%	47.8%
NY-J (NY City)		-	-	1.35	-	-	-	-	-	-	1.35	0.0%	-34.8%
NY-K (Long Island)		-	-	3.07	-	-	-	-	-	1.08	4.15	-4.0%	-12.6%
	2023 Total All Zones	-	-	6.92	0.59	-	-	-	-	3.09	10.60	-14.8%	-37.8%
NY-AB (West)		-	-	0.60	-	-	-	-	-	0.55	1.15	-58.7%	-81.4%
NY-CDE (Cent North)		-	-	0.80	0.59	-	-	-	-	0.72	2.11	0.9%	-11.5%
NY-F (Capital)		-	-	0.56	-	-	-	-	-	0.11	0.67	0.0%	-21.3%
NY-GHI (Southeast)		-	-	0.57	-	-	-	-	-	0.64	1.21	0.8%	47.8%
NY-J (NY City)		-	-	1.33	-	-	-	-	-	-	1.33	-2.7%	-35.7%
NY-K (Long Island)		-	-	3.05	-	-	-	-	-	1.08	4.14	-4.6%	-13.0%
	2024 Total All Zones	-	-	6.64	0.60	-	-	-	-	3.10	10.34	-16.9%	-39.4%
NY-AB (West)		-	-	0.59	-	-	-	-	-	0.55	1.14	-62.1%	-81.6%
NY-CDE (Cent North)		-	-	0.78	0.60	-	-	-	-	0.72	2.10	0.4%	-11.8%
NY-F (Capital)		-	-	0.56	-	-	-	-	-	0.11	0.67	0.0%	-21.3%
NY-GHI (Southeast)		-	-	0.54	-	-	-	-	-	0.65	1.18	0.0%	44.4%
NY-J (NY City)		-	-	1.25	-	-	-	-	-	-	1.25	-6.8%	-39.2%
NY-K (Long Island)		-	-	2.91	-	-	-	-	-	1.08	3.99	-3.7%	-16.1%
	2025 Total All Zones	-	-	6.37	0.58	-	-	-	-	3.09	10.05	-16.2%	-41.1%
NY-AB (West)		-	-	0.58	-	-	-	-	-	0.55	1.13	-60.0%	-81.7%
NY-CDE (Cent North)		-	-	0.75	0.58	-	-	-	-	0.72	2.05	-1.3%	-14.1%
NY-F (Capital)		-	-	0.51	-	-	-	-	-	0.11	0.62	-4.2%	-27.7%
NY-GHI (Southeast)		-	-	0.52	-	-	-	-	-	0.64	1.15	-1.6%	41.1%
NY-J (NY City)		-	-	1.22	-	-	-	-	-	-	1.22	-2.9%	-41.0%
NY-K (Long Island)		-	-	2.80	-	-	-	-	-	1.08	3.88	-3.6%	-18.4%

NOx, metric Ktons											% Change from Sc. 1	% Change from 2015 this Scenario
Scenario 31 - IPEC 2 Seq. Years base	Nuclear	Hydro&PS	NatGas	Coal	Oil 6	Oil 2	Ker	Wind	Other (Wood, Refuse, Bio, PV, DR/LaaR)	Total		
	-	-	-	-	-	-	-	-	-	-		
2015 Total All Zones	-	-	9.46	6.14	-	-	-	-	3.09	18.69	0.0%	0.0%
NY-AB (West)	-	-	0.73	5.41	-	-	-	-	0.55	6.68	0.0%	0.0%
NY-CDE (Cent North)	-	-	1.02	0.73	-	-	-	-	0.72	2.46	0.0%	0.0%
NY-F (Capital)	-	-	0.80	-	-	-	-	-	0.11	0.91	0.0%	0.0%
NY-GHI (Southeast)	-	-	0.37	-	-	-	-	-	0.64	1.01	0.0%	0.0%
NY-J (NY City)	-	-	2.60	-	-	-	-	-	-	2.60	0.0%	0.0%
NY-K (Long Island)	-	-	3.95	-	-	-	-	-	1.08	5.03	0.0%	0.0%
2016 Total All Zones	-	-	10.03	5.72	-	0.01	-	-	3.11	18.86	4.4%	0.9%
NY-AB (West)	-	-	0.72	4.99	-	-	-	-	0.55	6.26	0.7%	-6.3%
NY-CDE (Cent North)	-	-	1.01	0.73	-	-	-	-	0.72	2.45	1.1%	-0.4%
NY-F (Capital)	-	-	0.80	-	-	-	-	-	0.11	0.91	2.0%	0.0%
NY-GHI (Southeast)	-	-	0.54	-	-	-	-	-	0.65	1.18	15.0%	17.1%
NY-J (NY City)	-	-	2.91	-	-	-	-	-	-	2.91	20.8%	11.9%
NY-K (Long Island)	-	-	4.05	-	-	0.01	-	-	1.08	5.15	1.1%	2.4%
2017 Total All Zones	-	-	9.67	5.61	0.03	-	-	-	3.09	18.40	8.2%	-1.6%
NY-AB (West)	-	-	0.75	4.88	-	-	-	-	0.55	6.17	7.1%	-7.6%
NY-CDE (Cent North)	-	-	1.03	0.73	0.03	-	-	-	0.72	2.50	5.0%	1.5%
NY-F (Capital)	-	-	0.80	-	-	-	-	-	0.11	0.91	8.7%	0.0%
NY-GHI (Southeast)	-	-	0.61	-	-	-	-	-	0.64	1.25	19.1%	23.4%
NY-J (NY City)	-	-	2.54	-	-	-	-	-	-	2.54	24.0%	-2.4%
NY-K (Long Island)	-	-	3.95	-	-	-	-	-	1.08	5.04	2.0%	0.2%
2018 Total All Zones	-	-	7.97	4.37	-	-	-	-	3.09	15.44	8.1%	-17.4%
NY-AB (West)	-	-	0.64	3.68	-	-	-	-	0.55	4.86	15.8%	-27.2%
NY-CDE (Cent North)	-	-	0.89	0.69	-	-	-	-	0.72	2.30	2.4%	-6.6%
NY-F (Capital)	-	-	0.67	-	-	-	-	-	0.11	0.78	10.3%	-14.0%
NY-GHI (Southeast)	-	-	0.53	-	-	-	-	-	0.64	1.16	9.4%	15.3%
NY-J (NY City)	-	-	1.63	-	-	-	-	-	-	1.63	14.7%	-37.4%
NY-K (Long Island)	-	-	3.62	-	-	-	-	-	1.08	4.70	1.2%	-6.5%
2019 Total All Zones	-	-	7.65	3.80	-	-	-	-	3.09	14.54	0.1%	-22.2%
NY-AB (West)	-	-	0.63	3.12	-	-	-	-	0.55	4.29	0.0%	-35.8%
NY-CDE (Cent North)	-	-	0.85	0.68	-	-	-	-	0.72	2.25	0.4%	-8.5%
NY-F (Capital)	-	-	0.62	-	-	-	-	-	0.11	0.73	0.0%	-20.0%
NY-GHI (Southeast)	-	-	0.49	-	-	-	-	-	0.64	1.13	0.8%	11.7%
NY-J (NY City)	-	-	1.43	-	-	-	-	-	-	1.43	0.0%	-45.1%
NY-K (Long Island)	-	-	3.63	-	-	-	-	-	1.08	4.71	0.0%	-6.3%
2020 Total All Zones	-	-	7.55	2.73	-	-	-	-	3.11	13.39	-0.1%	-28.4%
NY-AB (West)	-	-	0.62	2.11	-	-	-	-	0.55	3.28	0.0%	-50.9%
NY-CDE (Cent North)	-	-	0.84	0.62	-	-	-	-	0.72	2.17	0.0%	-11.8%
NY-F (Capital)	-	-	0.62	-	-	-	-	-	0.11	0.73	0.0%	-20.0%
NY-GHI (Southeast)	-	-	0.51	-	-	-	-	-	0.65	1.15	0.0%	14.4%
NY-J (NY City)	-	-	1.43	-	-	-	-	-	-	1.43	0.0%	-45.1%
NY-K (Long Island)	-	-	3.55	-	-	-	-	-	1.08	4.63	-0.4%	-8.0%
2021 Total All Zones	-	-	7.23	2.57	0.02	-	-	-	3.09	12.91	0.1%	-30.9%
NY-AB (West)	-	-	0.61	1.97	-	-	-	-	0.55	3.13	0.0%	-53.2%
NY-CDE (Cent North)	-	-	0.83	0.60	0.02	-	-	-	0.72	2.16	0.0%	-12.2%
NY-F (Capital)	-	-	0.58	-	-	-	-	-	0.11	0.69	0.0%	-24.0%
NY-GHI (Southeast)	-	-	0.60	-	-	-	-	-	0.64	1.24	1.5%	22.5%
NY-J (NY City)	-	-	1.33	-	-	-	-	-	-	1.33	0.0%	-49.0%
NY-K (Long Island)	-	-	3.28	-	-	-	-	-	1.08	4.36	0.0%	-13.2%
2022 Total All Zones	-	-	7.10	2.09	-	-	-	-	3.09	12.28	0.1%	-34.3%
NY-AB (West)	-	-	0.59	1.51	-	-	-	-	0.55	2.65	0.0%	-60.4%
NY-CDE (Cent North)	-	-	0.79	0.58	-	-	-	-	0.72	2.09	0.0%	-15.1%
NY-F (Capital)	-	-	0.57	-	-	-	-	-	0.11	0.68	0.0%	-25.0%
NY-GHI (Southeast)	-	-	0.55	-	-	-	-	-	0.64	1.19	0.8%	18.0%
NY-J (NY City)	-	-	1.35	-	-	-	-	-	-	1.35	0.0%	-48.3%
NY-K (Long Island)	-	-	3.25	-	-	-	-	-	1.08	4.33	0.0%	-13.9%
2023 Total All Zones	-	-	7.12	2.24	-	-	-	-	3.09	12.45	0.1%	-33.4%
NY-AB (West)	-	-	0.58	1.65	-	-	-	-	0.55	2.77	0.0%	-58.5%
NY-CDE (Cent North)	-	-	0.78	0.59	-	-	-	-	0.72	2.09	0.0%	-15.1%
NY-F (Capital)	-	-	0.57	-	-	-	-	-	0.11	0.68	1.4%	-25.0%
NY-GHI (Southeast)	-	-	0.56	-	-	-	-	-	0.64	1.20	0.0%	18.9%
NY-J (NY City)	-	-	1.36	-	-	-	-	-	-	1.36	0.0%	-47.6%
NY-K (Long Island)	-	-	3.25	-	-	-	-	-	1.08	4.34	0.0%	-13.7%
2024 Total All Zones	-	-	6.89	2.47	-	-	-	-	3.11	12.47	0.3%	-33.3%
NY-AB (West)	-	-	0.58	1.86	-	-	-	-	0.55	3.00	0.0%	-55.1%
NY-CDE (Cent North)	-	-	0.78	0.61	-	-	-	-	0.72	2.11	0.9%	-14.4%
NY-F (Capital)	-	-	0.56	-	-	-	-	-	0.11	0.67	0.0%	-26.0%
NY-GHI (Southeast)	-	-	0.54	-	-	-	-	-	0.65	1.18	0.0%	17.1%
NY-J (NY City)	-	-	1.36	-	-	-	-	-	-	1.36	1.4%	-47.6%
NY-K (Long Island)	-	-	3.06	-	-	-	-	-	1.08	4.15	0.0%	-17.5%
2025 Total All Zones	-	-	6.62	2.28	-	-	-	-	3.10	12.00	0.1%	-35.8%
NY-AB (West)	-	-	0.58	1.69	-	-	-	-	0.55	2.82	0.0%	-57.8%
NY-CDE (Cent North)	-	-	0.75	0.59	-	-	-	-	0.73	2.07	0.0%	-15.9%
NY-F (Capital)	-	-	0.54	-	-	-	-	-	0.11	0.65	0.0%	-29.0%
NY-GHI (Southeast)	-	-	0.55	-	-	-	-	-	0.64	1.18	0.8%	17.1%
NY-J (NY City)	-	-	1.25	-	-	-	-	-	-	1.25	0.0%	-51.7%
NY-K (Long Island)	-	-	2.95	-	-	-	-	-	1.08	4.03	0.0%	-19.9%

NOx, metric Ktons	% Change from Sc. 1	% Change from 2015 this Scenario

NOx, metric Ktons												% Change from Sc. 1	% Change from 2015 this Scenario
Scenario 34 - IPEC 2 Seq. Years Hi EE, Wind, PV	Nuclear	Hydro&PS	NatGas	Coal	Oil 6	Oil 2	Ker	Wind	Other (Wood, Refuse, Bio, PV, DR/LaaR)	Total		
2015 Total All Zones	-	-	**8.29**	**5.66**	-	-	-	-	**3.09**	**17.05**	-8.8%	0.0%
NY-AB (West)	-	-	**0.67**	**4.95**	-	-	-	-	**0.55**	**6.17**	-7.6%	0.0%
NY-CDE (Cent North)	-	-	**0.95**	**0.71**	-	-	-	-	**0.72**	**2.38**	-3.3%	0.0%
NY-F (Capital)	-	-	**0.75**	-	-	-	-	-	**0.11**	**0.85**	-6.0%	0.0%
NY-GHI (Southeast)	-	-	**0.18**	-	-	-	-	-	**0.64**	**0.82**	-18.9%	0.0%
NY-J (NY City)	-	-	**2.06**	-	-	-	-	-	-	**2.06**	-20.6%	0.0%
NY-K (Long Island)	-	-	**3.67**	-	-	-	-	-	**1.08**	**4.75**	-5.4%	0.0%
2016 Total All Zones	-	-	**9.31**	**0.81**	-	-	-	-	**3.11**	**13.23**	-26.8%	-22.4%
NY-AB (West)	-	-	**0.74**	**0.11**	-	-	-	-	**0.55**	**1.40**	-77.5%	-77.3%
NY-CDE (Cent North)	-	-	**1.01**	**0.70**	-	-	-	-	**0.72**	**2.43**	0.0%	1.9%
NY-F (Capital)	-	-	**0.78**	-	-	-	-	-	**0.11**	**0.89**	0.0%	4.3%
NY-GHI (Southeast)	-	-	**0.46**	-	-	-	-	-	**0.65**	**1.11**	8.0%	35.6%
NY-J (NY City)	-	-	**2.50**	-	-	-	-	-	-	**2.50**	3.8%	21.1%
NY-K (Long Island)	-	-	**3.82**	-	-	-	-	-	**1.08**	**4.90**	-3.8%	3.1%
2017 Total All Zones	-	-	**8.98**	**0.81**	-	-	-	-	**3.09**	**12.88**	-24.3%	-24.4%
NY-AB (West)	-	-	**0.74**	**0.10**	-	-	-	-	**0.55**	**1.38**	-76.0%	-77.6%
NY-CDE (Cent North)	-	-	**1.00**	**0.71**	-	-	-	-	**0.72**	**2.43**	1.9%	1.9%
NY-F (Capital)	-	-	**0.78**	-	-	-	-	-	**0.11**	**0.89**	6.5%	4.3%
NY-GHI (Southeast)	-	-	**0.52**	-	-	-	-	-	**0.64**	**1.15**	10.4%	41.1%
NY-J (NY City)	-	-	**2.19**	-	-	-	-	-	-	**2.19**	7.1%	6.2%
NY-K (Long Island)	-	-	**3.75**	-	-	-	-	-	**1.08**	**4.84**	-2.0%	1.7%
2018 Total All Zones	-	-	**7.27**	**0.72**	-	-	-	-	**3.09**	**11.08**	-22.4%	-35.0%
NY-AB (West)	-	-	**0.63**	**0.05**	-	-	-	-	**0.55**	**1.22**	-71.0%	-80.3%
NY-CDE (Cent North)	-	-	**0.86**	**0.67**	-	-	-	-	**0.72**	**2.25**	0.4%	-5.3%
NY-F (Capital)	-	-	**0.62**	-	-	-	-	-	**0.11**	**0.73**	2.6%	-14.9%
NY-GHI (Southeast)	-	-	**0.45**	-	-	-	-	-	**0.64**	**1.09**	2.6%	33.3%
NY-J (NY City)	-	-	**1.33**	-	-	-	-	-	-	**1.33**	-6.4%	-35.7%
NY-K (Long Island)	-	-	**3.38**	-	-	-	-	-	**1.08**	**4.46**	-3.9%	-6.1%
2019 Total All Zones	-	-	**6.87**	**0.68**	-	-	-	-	**3.09**	**10.65**	-26.7%	-37.5%
NY-AB (West)	-	-	**0.61**	**0.03**	-	-	-	-	**0.55**	**1.18**	-72.5%	-80.9%
NY-CDE (Cent North)	-	-	**0.80**	**0.65**	-	-	-	-	**0.72**	**2.17**	-3.2%	-8.8%
NY-F (Capital)	-	-	**0.55**	-	-	-	-	-	**0.11**	**0.65**	-10.0%	-23.4%
NY-GHI (Southeast)	-	-	**0.40**	-	-	-	-	-	**0.64**	**1.04**	-7.3%	26.7%
NY-J (NY City)	-	-	**1.19**	-	-	-	-	-	-	**1.19**	-16.6%	-42.3%
NY-K (Long Island)	-	-	**3.33**	-	-	-	-	-	**1.08**	**4.41**	-6.4%	-7.3%
2020 Total All Zones	-	-	**6.75**	**0.59**	-	-	-	-	**3.11**	**10.45**	-22.1%	-38.7%
NY-AB (West)	-	-	**0.60**	-	-	-	-	-	**0.55**	**1.15**	-64.8%	-81.3%
NY-CDE (Cent North)	-	-	**0.79**	**0.59**	-	-	-	-	**0.72**	**2.10**	-3.3%	-11.8%
NY-F (Capital)	-	-	**0.54**	-	-	-	-	-	**0.11**	**0.65**	-11.3%	-24.5%
NY-GHI (Southeast)	-	-	**0.42**	-	-	-	-	-	**0.65**	**1.06**	-7.9%	30.0%
NY-J (NY City)	-	-	**1.15**	-	-	-	-	-	-	**1.15**	-19.1%	-44.1%
NY-K (Long Island)	-	-	**3.25**	-	-	-	-	-	**1.08**	**4.33**	-6.8%	-9.0%
2021 Total All Zones	-	-	**6.47**	**0.57**	-	-	-	-	**3.09**	**10.14**	-21.4%	-40.5%
NY-AB (West)	-	-	**0.59**	-	-	-	-	-	**0.55**	**1.14**	-63.7%	-81.6%
NY-CDE (Cent North)	-	-	**0.75**	**0.57**	-	-	-	-	**0.72**	**2.05**	-5.5%	-14.1%
NY-F (Capital)	-	-	**0.50**	-	-	-	-	-	**0.11**	**0.61**	-11.8%	-28.7%
NY-GHI (Southeast)	-	-	**0.48**	-	-	-	-	-	**0.64**	**1.12**	-8.2%	36.7%
NY-J (NY City)	-	-	**1.11**	-	-	-	-	-	-	**1.11**	-16.4%	-46.3%
NY-K (Long Island)	-	-	**3.04**	-	-	-	-	-	**1.08**	**4.12**	-5.6%	-13.4%
2022 Total All Zones	-	-	**6.32**	**0.55**	-	-	-	-	**3.09**	**9.95**	-18.9%	-41.6%
NY-AB (West)	-	-	**0.57**	-	-	-	-	-	**0.55**	**1.12**	-57.7%	-81.9%
NY-CDE (Cent North)	-	-	**0.74**	**0.55**	-	-	-	-	**0.72**	**2.00**	-4.3%	-16.0%
NY-F (Capital)	-	-	**0.48**	-	-	-	-	-	**0.11**	**0.59**	-13.3%	-30.9%
NY-GHI (Southeast)	-	-	**0.43**	-	-	-	-	-	**0.64**	**1.06**	-10.0%	30.0%
NY-J (NY City)	-	-	**1.11**	-	-	-	-	-	-	**1.11**	-17.6%	-46.3%
NY-K (Long Island)	-	-	**2.99**	-	-	-	-	-	**1.08**	**4.07**	-5.9%	-14.3%
2023 Total All Zones	-	-	**6.34**	**0.55**	-	-	-	-	**3.09**	**9.98**	-19.7%	-41.4%
NY-AB (West)	-	-	**0.56**	-	-	-	-	-	**0.55**	**1.11**	-60.0%	-82.0%
NY-CDE (Cent North)	-	-	**0.74**	**0.55**	-	-	-	-	**0.72**	**2.01**	-3.9%	-15.6%
NY-F (Capital)	-	-	**0.47**	-	-	-	-	-	**0.11**	**0.58**	-13.5%	-31.9%
NY-GHI (Southeast)	-	-	**0.46**	-	-	-	-	-	**0.64**	**1.10**	-8.3%	34.4%
NY-J (NY City)	-	-	**1.12**	-	-	-	-	-	-	**1.12**	-18.0%	-45.8%
NY-K (Long Island)	-	-	**2.98**	-	-	-	-	-	**1.08**	**4.06**	-6.3%	-14.5%
2024 Total All Zones	-	-	**6.07**	**0.56**	-	-	-	-	**3.10**	**9.74**	-21.7%	-42.9%
NY-AB (West)	-	-	**0.57**	-	-	-	-	-	**0.55**	**1.12**	-62.7%	-81.9%
NY-CDE (Cent North)	-	-	**0.73**	**0.56**	-	-	-	-	**0.72**	**2.01**	-3.9%	-15.6%
NY-F (Capital)	-	-	**0.48**	-	-	-	-	-	**0.11**	**0.59**	-12.2%	-30.9%
NY-GHI (Southeast)	-	-	**0.42**	-	-	-	-	-	**0.65**	**1.06**	-10.0%	30.0%
NY-J (NY City)	-	-	**1.06**	-	-	-	-	-	-	**1.06**	-20.9%	-48.5%
NY-K (Long Island)	-	-	**2.81**	-	-	-	-	-	**1.08**	**3.89**	-6.1%	-18.2%
2025 Total All Zones	-	-	**5.83**	**0.55**	-	-	-	-	**3.09**	**9.46**	-21.1%	-44.5%
NY-AB (West)	-	-	**0.55**	-	-	-	-	-	**0.55**	**1.10**	-61.0%	-82.2%
NY-CDE (Cent North)	-	-	**0.70**	**0.55**	-	-	-	-	**0.72**	**1.96**	-5.3%	-17.6%
NY-F (Capital)	-	-	**0.45**	-	-	-	-	-	**0.11**	**0.55**	-14.1%	-35.1%
NY-GHI (Southeast)	-	-	**0.37**	-	-	-	-	-	**0.64**	**1.01**	-14.0%	23.3%
NY-J (NY City)	-	-	**1.06**	-	-	-	-	-	-	**1.06**	-15.2%	-48.5%
NY-K (Long Island)	-	-	**2.69**	-	-	-	-	-	**1.08**	**3.77**	-6.3%	-20.7%

CO2 '000 metric tones											% Change from Sc. 1	% Change from 2015 this Scenario
Scenario 1 - IPEC In	Nuclear	Hydro&PS	NatGas	Coal	Oil 6	Oil 2	Ker	Wind	(Wood, Refuse, Bio, PV,	Total		
2015 Total All Zones	-	-	29,537	5,043	-	4	1	-	2,800	37,386	0.0%	0.0%
NY-AB (West)	-	-	880	4,597	-	-	-	-	772	6,249	0.0%	0.0%
NY-CDE (Cent North)	-	-	3,939	445	-	-	-	-	677	5,062	0.0%	0.0%
NY-F (Capital)	-	-	6,932	-	-	-	-	-	114	7,046	0.0%	0.0%
NY-GHI (Southeast)	-	-	502	-	-	-	-	-	508	1,009	0.0%	0.0%
NY-J (NY City)	-	-	11,287	-	-	-	-	-	-	11,287	0.0%	0.0%
NY-K (Long Island)	-	-	5,997	-	-	4	1	-	729	6,732	0.0%	0.0%
2016 Total All Zones	-	-	30,711	4,652	-	17	3	-	2,810	38,194	0.0%	2.2%
NY-AB (West)	-	-	858	4,224	-	-	-	-	774	5,856	0.0%	-6.3%
NY-CDE (Cent North)	-	-	3,852	429	-	-	-	-	681	4,962	0.0%	-2.0%
NY-F (Capital)	-	-	6,822	-	-	-	-	-	115	6,937	0.0%	-1.6%
NY-GHI (Southeast)	-	-	1,684	-	-	0	-	-	509	2,193	0.0%	117.3%
NY-J (NY City)	-	-	11,505	-	-	2	-	-	-	11,506	0.0%	1.9%
NY-K (Long Island)	-	-	5,990	-	-	16	3	-	731	6,739	0.0%	0.1%
2017 Total All Zones	-	-	30,342	4,268	3	7	1	-	2,803	37,425	0.0%	0.1%
NY-AB (West)	-	-	816	3,846	-	-	-	-	773	5,435	0.0%	-13.0%
NY-CDE (Cent North)	-	-	3,699	422	3	-	-	-	680	4,804	0.0%	-5.1%
NY-F (Capital)	-	-	6,384	-	-	-	-	-	114	6,498	0.0%	-7.8%
NY-GHI (Southeast)	-	-	2,219	-	-	-	-	-	508	2,727	0.0%	170.2%
NY-J (NY City)	-	-	11,463	-	-	0	-	-	-	11,463	0.0%	1.6%
NY-K (Long Island)	-	-	5,761	-	-	6	1	-	729	6,497	0.0%	-3.5%
2018 Total All Zones	-	-	29,081	2,958	-	2	1	-	2,795	34,836	0.0%	-6.8%
NY-AB (West)	-	-	734	2,563	-	-	-	-	765	4,061	0.0%	-35.0%
NY-CDE (Cent North)	-	-	3,362	395	-	-	-	-	679	4,436	0.0%	-12.4%
NY-F (Capital)	-	-	4,972	-	-	-	-	-	114	5,087	0.0%	-27.8%
NY-GHI (Southeast)	-	-	4,459	-	-	-	-	-	508	4,966	0.0%	392.1%
NY-J (NY City)	-	-	10,121	-	-	-	-	-	-	10,121	0.0%	-10.3%
NY-K (Long Island)	-	-	5,433	-	-	2	1	-	729	6,165	0.0%	-8.4%
2019 Total All Zones	-	-	28,915	3,022	-	3	0	-	2,801	34,742	0.0%	-7.1%
NY-AB (West)	-	-	727	2,626	-	-	-	-	769	4,122	0.0%	-34.0%
NY-CDE (Cent North)	-	-	3,383	396	-	-	-	-	681	4,460	0.0%	-11.9%
NY-F (Capital)	-	-	4,777	-	-	-	-	-	114	4,891	0.0%	-30.6%
NY-GHI (Southeast)	-	-	4,471	-	-	-	-	-	508	4,979	0.0%	393.3%
NY-J (NY City)	-	-	10,073	-	-	-	-	-	-	10,073	0.0%	-10.8%
NY-K (Long Island)	-	-	5,483	-	-	3	0	-	729	6,216	0.0%	-7.7%
2020 Total All Zones	-	-	30,058	2,078	-	2	1	-	2,801	34,940	0.0%	-6.5%
NY-AB (West)	-	-	720	1,720	-	-	-	-	765	3,205	0.0%	-48.7%
NY-CDE (Cent North)	-	-	3,330	357	-	-	-	-	683	4,370	0.0%	-13.7%
NY-F (Capital)	-	-	4,949	-	-	-	-	-	115	5,063	0.0%	-28.1%
NY-GHI (Southeast)	-	-	5,432	-	-	-	-	-	509	5,940	0.0%	488.6%
NY-J (NY City)	-	-	10,198	-	-	-	-	-	-	10,198	0.0%	-9.6%
NY-K (Long Island)	-	-	5,429	-	-	2	1	-	731	6,164	0.0%	-8.4%
2021 Total All Zones	-	-	31,074	1,957	10	1	1	-	2,819	35,863	0.0%	-4.1%
NY-AB (West)	-	-	712	1,611	-	-	-	-	765	3,088	0.0%	-50.6%
NY-CDE (Cent North)	-	-	3,267	346	10	-	-	-	697	4,320	0.0%	-14.7%
NY-F (Capital)	-	-	4,400	-	-	-	-	-	121	4,520	0.0%	-35.9%
NY-GHI (Southeast)	-	-	6,352	-	-	-	-	-	507	6,859	0.0%	579.6%
NY-J (NY City)	-	-	10,408	-	-	-	-	-	-	10,408	0.0%	-7.8%
NY-K (Long Island)	-	-	5,936	-	-	1	1	-	729	6,667	0.0%	-1.0%
2022 Total All Zones	-	-	31,313	1,579	-	2	0	-	2,821	35,715	0.0%	-4.5%
NY-AB (West)	-	-	686	1,243	-	-	-	-	762	2,692	0.0%	-56.9%
NY-CDE (Cent North)	-	-	3,204	336	-	-	-	-	702	4,241	0.0%	-16.2%
NY-F (Capital)	-	-	4,332	-	-	-	-	-	121	4,453	0.0%	-36.8%
NY-GHI (Southeast)	-	-	6,283	-	-	-	-	-	507	6,790	0.0%	572.8%
NY-J (NY City)	-	-	10,917	-	-	-	-	-	-	10,917	0.0%	-3.3%
NY-K (Long Island)	-	-	5,891	-	-	2	0	-	729	6,623	0.0%	-1.6%
2023 Total All Zones	-	-	31,344	1,681	-	3	1	-	2,885	35,914	0.0%	-3.9%
NY-AB (West)	-	-	682	1,342	-	-	-	-	763	2,786	0.0%	-55.4%
NY-CDE (Cent North)	-	-	3,168	339	-	-	-	-	766	4,273	0.0%	-15.6%
NY-F (Capital)	-	-	4,324	-	-	-	-	-	121	4,445	0.0%	-36.9%
NY-GHI (Southeast)	-	-	6,335	-	-	-	-	-	507	6,842	0.0%	577.9%
NY-J (NY City)	-	-	10,936	-	-	-	-	-	-	10,936	0.0%	-3.1%
NY-K (Long Island)	-	-	5,899	-	-	3	1	-	729	6,631	0.0%	-1.5%
2024 Total All Zones	-	-	31,395	1,849	-	1	0	-	2,895	36,140	0.0%	-3.3%
NY-AB (West)	-	-	683	1,502	-	-	-	-	763	2,947	0.0%	-52.8%
NY-CDE (Cent North)	-	-	3,162	348	-	-	-	-	772	4,282	0.0%	-15.4%
NY-F (Capital)	-	-	4,140	-	-	-	-	-	121	4,262	0.0%	-39.5%
NY-GHI (Southeast)	-	-	6,149	-	-	-	-	-	508	6,657	0.0%	559.6%
NY-J (NY City)	-	-	10,757	-	-	-	-	-	-	10,757	0.0%	-4.7%
NY-K (Long Island)	-	-	6,504	-	-	1	0	-	731	7,236	0.0%	7.5%
2025 Total All Zones	-	-	31,818	1,700	-	0	-	-	3,012	36,530	0.0%	-2.3%
NY-AB (West)	-	-	675	1,359	-	-	-	-	755	2,789	0.0%	-55.4%
NY-CDE (Cent North)	-	-	3,093	341	-	-	-	-	900	4,334	0.0%	-14.4%
NY-F (Capital)	-	-	3,763	-	-	-	-	-	121	3,884	0.0%	-44.9%
NY-GHI (Southeast)	-	-	5,838	-	-	-	-	-	507	6,344	0.0%	528.6%
NY-J (NY City)	-	-	11,279	-	-	-	-	-	-	11,279	0.0%	-0.1%
NY-K (Long Island)	-	-	7,170	-	-	0	-	-	729	7,899	0.0%	17.3%

CO2 '000 metric tones											% Change from Sc. 1	% Change from 2015 this Scenario
Scenario 11 - IPEC OOS	Nuclear	Hydro&PS	NatGas	Coal	Oil 6	Oil 2	Ker	Wind	(Wood, Refuse, Bio, PV,	Total		
2015 Total All Zones	-	-	29,537	5,043	-	4	1	-	2,800	37,386	0.0%	0.0%
NY-AB (West)	-	-	880	4,597	-	-	-	-	772	6,249	0.0%	0.0%
NY-CDE (Cent North)	-	-	3,939	445	-	-	-	-	677	5,062	0.0%	0.0%
NY-F (Capital)	-	-	6,932	-	-	-	-	-	114	7,046	0.0%	0.0%
NY-GHI (Southeast)	-	-	502	-	-	-	-	-	508	1,009	0.0%	0.0%
NY-J (NY City)	-	-	11,287	-	-	-	-	-	-	11,287	0.0%	0.0%
NY-K (Long Island)	-	-	5,997	-	-	4	1	-	729	6,732	0.0%	0.0%
2016 Total All Zones	-	-	34,811	5,546	15	27	3	-	2,816	43,219	13.2%	15.6%
NY-AB (West)	-	-	995	5,084	-	-	-	-	779	6,858	17.1%	9.7%
NY-CDE (Cent North)	-	-	4,280	462	15	-	-	-	682	5,440	9.6%	7.5%
NY-F (Capital)	-	-	7,704	-	-	-	-	-	115	7,819	12.7%	11.0%
NY-GHI (Southeast)	-	-	2,284	-	-	1	-	-	509	2,794	27.4%	176.9%
NY-J (NY City)	-	-	13,080	-	-	2	-	-	-	13,082	13.7%	15.9%
NY-K (Long Island)	-	-	6,467	-	-	25	3	-	731	7,226	7.2%	7.3%
2017 Total All Zones	-	-	34,480	5,106	37	15	2	-	2,809	42,449	13.4%	13.5%
NY-AB (West)	-	-	942	4,656	-	-	-	-	777	6,375	17.3%	2.0%
NY-CDE (Cent North)	-	-	4,099	450	37	-	-	-	681	5,266	9.6%	4.0%
NY-F (Capital)	-	-	7,463	-	-	-	-	-	115	7,578	16.6%	7.5%
NY-GHI (Southeast)	-	-	2,815	-	-	0	-	-	508	3,323	21.8%	229.2%
NY-J (NY City)	-	-	12,989	-	-	1	-	-	-	12,990	13.3%	15.1%
NY-K (Long Island)	-	-	6,172	-	-	14	2	-	729	6,917	6.5%	2.8%
2018 Total All Zones	-	-	33,425	3,857	-	3	1	-	2,803	40,089	15.1%	7.2%
NY-AB (West)	-	-	808	3,435	-	-	-	-	771	5,013	23.4%	-19.8%
NY-CDE (Cent North)	-	-	3,693	422	-	-	-	-	681	4,796	8.1%	-5.3%
NY-F (Capital)	-	-	6,332	-	-	-	-	-	114	6,447	26.7%	-8.5%
NY-GHI (Southeast)	-	-	5,241	-	-	-	-	-	508	5,749	15.8%	469.6%
NY-J (NY City)	-	-	11,707	-	-	-	-	-	-	11,707	15.7%	3.7%
NY-K (Long Island)	-	-	5,644	-	-	3	1	-	729	6,377	3.5%	-5.3%
2019 Total All Zones	-	-	33,297	3,890	8	4	1	-	2,809	40,008	15.2%	7.0%
NY-AB (West)	-	-	811	3,467	-	-	-	-	775	5,052	22.6%	-19.1%
NY-CDE (Cent North)	-	-	3,700	423	8	-	-	-	683	4,813	7.9%	-4.9%
NY-F (Capital)	-	-	6,199	-	-	-	-	-	114	6,313	29.1%	-10.4%
NY-GHI (Southeast)	-	-	5,244	-	-	-	-	-	508	5,752	15.5%	469.9%
NY-J (NY City)	-	-	11,651	-	-	-	-	-	-	11,651	15.7%	3.2%
NY-K (Long Island)	-	-	5,693	-	-	4	1	-	729	6,426	3.4%	-4.5%
2020 Total All Zones	-	-	34,408	2,814	-	3	1	-	2,810	40,036	14.6%	7.1%
NY-AB (West)	-	-	796	2,430	-	-	-	-	771	3,997	24.7%	-36.0%
NY-CDE (Cent North)	-	-	3,669	384	-	-	-	-	685	4,737	8.4%	-6.4%
NY-F (Capital)	-	-	6,466	-	-	-	-	-	115	6,580	30.0%	-6.6%
NY-GHI (Southeast)	-	-	6,290	-	-	-	-	-	509	6,799	14.5%	573.6%
NY-J (NY City)	-	-	11,560	-	-	-	-	-	-	11,560	13.4%	2.4%
NY-K (Long Island)	-	-	5,628	-	-	3	1	-	731	6,363	3.2%	-5.5%
2021 Total All Zones	-	-	35,269	2,627	11	2	1	-	2,827	40,737	13.6%	9.0%
NY-AB (West)	-	-	761	2,254	-	-	-	-	770	3,786	22.6%	-39.4%
NY-CDE (Cent North)	-	-	3,568	372	11	-	-	-	699	4,651	7.6%	-8.1%
NY-F (Capital)	-	-	5,903	-	-	-	-	-	121	6,024	33.3%	-14.5%
NY-GHI (Southeast)	-	-	7,147	-	-	-	-	-	508	7,655	11.6%	658.4%
NY-J (NY City)	-	-	11,779	-	-	0	-	-	-	11,780	13.2%	4.4%
NY-K (Long Island)	-	-	6,110	-	-	2	1	-	729	6,842	2.6%	1.6%
2022 Total All Zones	-	-	35,530	2,240	-	2	0	-	2,830	40,602	13.7%	8.6%
NY-AB (West)	-	-	734	1,877	-	-	-	-	769	3,379	25.6%	-45.9%
NY-CDE (Cent North)	-	-	3,486	363	-	-	-	-	703	4,552	7.3%	-10.1%
NY-F (Capital)	-	-	5,736	-	-	-	-	-	121	5,858	31.5%	-16.9%
NY-GHI (Southeast)	-	-	7,134	-	-	-	-	-	508	7,641	12.5%	657.1%
NY-J (NY City)	-	-	12,362	-	-	-	-	-	-	12,362	13.2%	9.5%
NY-K (Long Island)	-	-	6,078	-	-	2	0	-	729	6,809	2.8%	1.2%
2023 Total All Zones	-	-	35,413	2,476	7	4	1	-	2,895	40,796	13.6%	9.1%
NY-AB (West)	-	-	726	2,111	-	-	-	-	769	3,606	29.4%	-42.3%
NY-CDE (Cent North)	-	-	3,437	365	7	-	-	-	768	4,577	7.1%	-9.6%
NY-F (Capital)	-	-	5,682	-	-	-	-	-	121	5,803	30.6%	-17.6%
NY-GHI (Southeast)	-	-	7,096	-	-	-	-	-	508	7,603	11.1%	653.3%
NY-J (NY City)	-	-	12,391	-	-	-	-	-	-	12,391	13.3%	9.8%
NY-K (Long Island)	-	-	6,082	-	-	4	1	-	729	6,815	2.8%	1.2%
2024 Total All Zones	-	-	35,487	2,599	-	1	0	-	2,905	40,991	13.4%	9.6%
NY-AB (West)	-	-	719	2,232	-	-	-	-	768	3,719	26.2%	-40.5%
NY-CDE (Cent North)	-	-	3,396	367	-	-	-	-	776	4,538	6.0%	-10.4%
NY-F (Capital)	-	-	5,501	-	-	-	-	-	121	5,623	31.9%	-20.2%
NY-GHI (Southeast)	-	-	7,033	-	-	-	-	-	509	7,543	13.3%	647.3%
NY-J (NY City)	-	-	12,092	-	-	-	-	-	-	12,092	12.4%	7.1%
NY-K (Long Island)	-	-	6,746	-	-	1	0	-	731	7,477	3.3%	11.1%
2025 Total All Zones	-	-	35,976	2,176	11	0	-	-	3,030	41,193	12.8%	10.2%
NY-AB (West)	-	-	710	1,816	-	-	-	-	763	3,289	17.9%	-47.4%
NY-CDE (Cent North)	-	-	3,307	359	11	-	-	-	909	4,587	5.8%	-9.4%
NY-F (Capital)	-	-	4,889	-	-	-	-	-	121	5,010	29.0%	-28.9%
NY-GHI (Southeast)	-	-	6,769	-	-	-	-	-	508	7,277	14.7%	621.0%
NY-J (NY City)	-	-	12,859	-	-	-	-	-	-	12,859	14.0%	13.9%
NY-K (Long Island)	-	-	7,442	-	-	0	-	-	729	8,171	3.4%	21.4%

CO2 '000 metric tones											% Change from Sc. 1	% Change from 2015 this Scenario
Scenario 14 - IPEC OOS Hi EE, W	Nuclear	Hydro&PS	NatGas	Coal	Oil 6	Oil 2	Ker	Wind	(Wood, Refuse, Bio, PV,	Total		
2015 Total All Zones	-	-	27,066	4,607	-	3	0	-	2,782	34,458	-7.8%	0.0%
NY-AB (West)	-	-	813	4,184	-	-	-	-	761	5,758	-7.8%	0.0%
NY-CDE (Cent North)	-	-	3,723	423	-	-	-	-	671	4,817	-4.8%	0.0%
NY-F (Capital)	-	-	6,438	-	-	-	-	-	114	6,552	-7.0%	0.0%
NY-GHI (Southeast)	-	-	274	-	-	-	-	-	507	782	-22.5%	0.0%
NY-J (NY City)	-	-	10,234	-	-	-	-	-	-	10,234	-9.3%	0.0%
NY-K (Long Island)	-	-	5,583	-	-	3	0	-	729	6,315	-6.2%	0.0%
2016 Total All Zones	-	-	33,457	523	-	18	3	-	2,806	36,807	-3.6%	6.8%
NY-AB (West)	-	-	1,015	74	-	-	-	-	773	1,862	-68.2%	-67.7%
NY-CDE (Cent North)	-	-	4,245	450	-	-	-	-	678	5,372	8.3%	11.5%
NY-F (Capital)	-	-	7,532	-	-	-	-	-	115	7,647	10.2%	16.7%
NY-GHI (Southeast)	-	-	2,150	-	-	1	-	-	509	2,660	21.3%	240.3%
NY-J (NY City)	-	-	12,343	-	-	1	-	-	-	12,345	7.3%	20.6%
NY-K (Long Island)	-	-	6,171	-	-	16	3	-	731	6,921	2.7%	9.6%
2017 Total All Zones	-	-	32,821	495	4	7	1	-	2,802	36,130	-3.5%	4.9%
NY-AB (West)	-	-	944	59	-	-	-	-	773	1,776	-67.3%	-69.2%
NY-CDE (Cent North)	-	-	4,015	436	4	-	-	-	678	5,133	6.8%	6.6%
NY-F (Capital)	-	-	7,172	-	-	-	-	-	114	7,286	12.1%	11.2%
NY-GHI (Southeast)	-	-	2,631	-	-	0	-	-	508	3,139	15.1%	301.5%
NY-J (NY City)	-	-	12,215	-	-	0	-	-	-	12,215	6.6%	19.4%
NY-K (Long Island)	-	-	5,844	-	-	7	1	-	729	6,581	1.3%	4.2%
2018 Total All Zones	-	-	30,905	435	-	2	0	-	2,787	34,129	-2.0%	-1.0%
NY-AB (West)	-	-	790	29	-	-	-	-	761	1,580	-61.1%	-72.6%
NY-CDE (Cent North)	-	-	3,564	406	-	-	-	-	674	4,644	4.7%	-3.6%
NY-F (Capital)	-	-	5,645	-	-	-	-	-	114	5,760	13.2%	-12.1%
NY-GHI (Southeast)	-	-	4,985	-	-	-	-	-	508	5,492	10.6%	602.5%
NY-J (NY City)	-	-	10,662	-	-	-	-	-	-	10,662	5.3%	4.2%
NY-K (Long Island)	-	-	5,260	-	-	2	0	-	729	5,991	-2.8%	-5.1%
2019 Total All Zones	-	-	30,415	433	-	1	-	-	2,799	33,649	-3.1%	-2.3%
NY-AB (West)	-	-	784	27	-	-	-	-	768	1,580	-61.7%	-72.6%
NY-CDE (Cent North)	-	-	3,570	406	-	-	-	-	680	4,656	4.4%	-3.3%
NY-F (Capital)	-	-	5,349	-	-	-	-	-	114	5,463	11.7%	-16.6%
NY-GHI (Southeast)	-	-	4,944	-	-	-	-	-	508	5,452	9.5%	597.3%
NY-J (NY City)	-	-	10,495	-	-	-	-	-	-	10,495	4.2%	2.5%
NY-K (Long Island)	-	-	5,273	-	-	1	-	-	729	6,003	-3.4%	-4.9%
2020 Total All Zones	-	-	30,843	372	-	1	-	-	2,799	34,015	-2.6%	-1.3%
NY-AB (West)	-	-	757	5	-	-	-	-	763	1,525	-52.4%	-73.5%
NY-CDE (Cent North)	-	-	3,474	367	-	-	-	-	681	4,523	3.5%	-6.1%
NY-F (Capital)	-	-	5,324	-	-	-	-	-	115	5,439	7.4%	-17.0%
NY-GHI (Southeast)	-	-	5,809	-	-	-	-	-	509	6,318	6.4%	708.2%
NY-J (NY City)	-	-	10,294	-	-	-	-	-	-	10,294	0.9%	0.6%
NY-K (Long Island)	-	-	5,184	-	-	1	-	-	731	5,916	-4.0%	-6.3%
2021 Total All Zones	-	-	31,546	354	-	1	0	-	2,815	34,716	-3.2%	0.7%
NY-AB (West)	-	-	732	1	-	-	-	-	762	1,495	-51.6%	-74.0%
NY-CDE (Cent North)	-	-	3,352	354	-	-	-	-	696	4,402	1.9%	-8.6%
NY-F (Capital)	-	-	4,724	-	-	-	-	-	121	4,845	7.2%	-26.0%
NY-GHI (Southeast)	-	-	6,613	-	-	-	-	-	508	7,120	3.8%	810.7%
NY-J (NY City)	-	-	10,437	-	-	-	-	-	-	10,437	0.3%	2.0%
NY-K (Long Island)	-	-	5,687	-	-	1	0	-	729	6,417	-3.7%	1.6%
2022 Total All Zones	-	-	31,280	335	-	0	-	-	2,812	34,427	-3.6%	-0.1%
NY-AB (West)	-	-	703	-	-	-	-	-	757	1,460	-45.8%	-74.7%
NY-CDE (Cent North)	-	-	3,253	335	-	-	-	-	698	4,286	1.1%	-11.0%
NY-F (Capital)	-	-	4,437	-	-	-	-	-	121	4,558	2.4%	-30.4%
NY-GHI (Southeast)	-	-	6,400	-	-	-	-	-	508	6,907	1.7%	783.5%
NY-J (NY City)	-	-	10,874	-	-	-	-	-	-	10,874	-0.4%	6.3%
NY-K (Long Island)	-	-	5,613	-	-	0	-	-	729	6,342	-4.2%	0.4%
2023 Total All Zones	-	-	30,916	341	-	1	0	-	2,871	34,129	-5.0%	-1.0%
NY-AB (West)	-	-	692	1	-	-	-	-	754	1,447	-48.1%	-74.9%
NY-CDE (Cent North)	-	-	3,186	340	-	-	-	-	759	4,285	0.3%	-11.0%
NY-F (Capital)	-	-	4,319	-	-	-	-	-	121	4,440	-0.1%	-32.2%
NY-GHI (Southeast)	-	-	6,455	-	-	-	-	-	508	6,963	1.8%	790.6%
NY-J (NY City)	-	-	10,669	-	-	-	-	-	-	10,669	-2.4%	4.3%
NY-K (Long Island)	-	-	5,595	-	-	1	0	-	729	6,324	-4.6%	0.1%
2024 Total All Zones	-	-	30,681	343	-	-	-	-	2,871	33,895	-6.2%	-1.6%
NY-AB (West)	-	-	688	-	-	-	-	-	749	1,437	-51.3%	-75.1%
NY-CDE (Cent North)	-	-	3,147	343	-	-	-	-	762	4,252	-0.7%	-11.7%
NY-F (Capital)	-	-	4,082	-	-	-	-	-	121	4,204	-1.4%	-35.8%
NY-GHI (Southeast)	-	-	6,173	-	-	-	-	-	509	6,682	0.4%	754.6%
NY-J (NY City)	-	-	10,342	-	-	-	-	-	-	10,342	-3.9%	1.1%
NY-K (Long Island)	-	-	6,249	-	-	-	-	-	731	6,980	-3.5%	10.5%
2025 Total All Zones	-	-	30,808	334	-	-	-	-	2,980	34,122	-6.6%	-1.0%
NY-AB (West)	-	-	668	-	-	-	-	-	740	1,408	-49.5%	-75.5%
NY-CDE (Cent North)	-	-	3,058	334	-	-	-	-	882	4,273	-1.4%	-11.3%
NY-F (Capital)	-	-	3,606	-	-	-	-	-	121	3,727	-4.0%	-43.1%
NY-GHI (Southeast)	-	-	5,764	-	-	-	-	-	508	6,272	-1.1%	702.2%
NY-J (NY City)	-	-	10,769	-	-	-	-	-	-	10,769	-4.5%	5.2%
NY-K (Long Island)	-	-	6,942	-	-	-	-	-	729	7,671	-2.9%	21.5%

CO2 '000 metric tones											% Change from Sc. 1	% Change from 2015 this Scenario
Scenario 31 - IPEC 2 Seq. Years b	Nuclear	Hydro&PS	NatGas	Coal	Oil 6	Oil 2	Ker	Wind	Other (Wood, Refuse, Bio, PV,	Total		
2015 Total All Zones	-	-	29,537	5,043	-	4	1	-	2,800	37,386	0.0%	0.0%
NY-AB (West)	-	-	880	4,597	-	-	-	-	772	6,249	0.0%	0.0%
NY-CDE (Cent North)	-	-	3,939	445	-	-	-	-	677	5,062	0.0%	0.0%
NY-F (Capital)	-	-	6,932	-	-	-	-	-	114	7,046	0.0%	0.0%
NY-GHI (Southeast)	-	-	502	-	-	-	-	-	508	1,009	0.0%	0.0%
NY-J (NY City)	-	-	11,287	-	-	-	-	-	-	11,287	0.0%	0.0%
NY-K (Long Island)	-	-	5,997	-	-	4	1	-	729	6,732	0.0%	0.0%
2016 Total All Zones	-	-	31,431	4,702	7	22	3	-	2,811	38,977	2.1%	4.3%
NY-AB (West)	-	-	872	4,266	-	-	-	-	775	5,914	1.0%	-5.4%
NY-CDE (Cent North)	-	-	3,902	436	7	-	-	-	681	5,027	1.3%	-0.7%
NY-F (Capital)	-	-	6,938	-	-	-	-	-	115	7,053	1.7%	0.1%
NY-GHI (Southeast)	-	-	1,906	-	-	0	-	-	509	2,416	10.2%	139.4%
NY-J (NY City)	-	-	11,774	-	-	2	-	-	-	11,775	2.3%	4.3%
NY-K (Long Island)	-	-	6,039	-	-	20	3	-	731	6,793	0.8%	0.9%
2017 Total All Zones	-	-	32,793	4,603	28	14	2	-	2,807	40,248	7.5%	7.7%
NY-AB (West)	-	-	894	4,166	-	-	-	-	775	5,835	7.4%	-6.6%
NY-CDE (Cent North)	-	-	3,949	438	28	-	-	-	680	5,095	6.1%	0.7%
NY-F (Capital)	-	-	7,051	-	-	-	-	-	114	7,165	10.3%	1.7%
NY-GHI (Southeast)	-	-	2,606	-	-	0	-	-	508	3,114	14.2%	208.6%
NY-J (NY City)	-	-	12,329	-	-	1	-	-	-	12,330	7.6%	9.2%
NY-K (Long Island)	-	-	5,965	-	-	13	2	-	729	6,708	3.2%	-0.3%
2018 Total All Zones	-	-	31,259	3,518	-	2	1	-	2,799	37,580	7.9%	0.5%
NY-AB (West)	-	-	762	3,110	-	-	-	-	768	4,640	14.3%	-25.7%
NY-CDE (Cent North)	-	-	3,523	408	-	-	-	-	680	4,611	3.9%	-8.9%
NY-F (Capital)	-	-	5,655	-	-	-	-	-	114	5,769	13.4%	-18.1%
NY-GHI (Southeast)	-	-	4,937	-	-	-	-	-	508	5,445	9.6%	439.5%
NY-J (NY City)	-	-	10,857	-	-	-	-	-	-	10,857	7.3%	-3.8%
NY-K (Long Island)	-	-	5,525	-	-	2	1	-	729	6,257	1.5%	-7.0%
2019 Total All Zones	-	-	29,079	3,026	-	3	0	-	2,803	34,911	0.5%	-6.6%
NY-AB (West)	-	-	729	2,628	-	-	-	-	770	4,127	0.1%	-34.0%
NY-CDE (Cent North)	-	-	3,390	398	-	-	-	-	681	4,470	0.2%	-11.7%
NY-F (Capital)	-	-	4,818	-	-	-	-	-	114	4,932	0.8%	-30.0%
NY-GHI (Southeast)	-	-	4,543	-	-	-	-	-	508	5,050	1.4%	400.4%
NY-J (NY City)	-	-	10,106	-	-	-	-	-	-	10,106	0.3%	-10.5%
NY-K (Long Island)	-	-	5,493	-	-	3	0	-	729	6,226	0.2%	-7.5%
2020 Total All Zones	-	-	30,239	2,080	-	2	1	-	2,802	35,125	0.5%	-6.0%
NY-AB (West)	-	-	721	1,722	-	-	-	-	765	3,207	0.1%	-48.7%
NY-CDE (Cent North)	-	-	3,335	358	-	-	-	-	683	4,376	0.2%	-13.5%
NY-F (Capital)	-	-	5,037	-	-	-	-	-	115	5,152	1.7%	-26.9%
NY-GHI (Southeast)	-	-	5,473	-	-	-	-	-	509	5,981	0.7%	492.6%
NY-J (NY City)	-	-	10,239	-	-	-	-	-	-	10,239	0.4%	-9.3%
NY-K (Long Island)	-	-	5,434	-	-	2	1	-	731	6,169	0.1%	-8.4%
2021 Total All Zones	-	-	31,253	1,960	10	1	1	-	2,821	36,046	0.5%	-3.6%
NY-AB (West)	-	-	712	1,613	-	-	-	-	766	3,091	0.1%	-50.5%
NY-CDE (Cent North)	-	-	3,268	347	10	-	-	-	698	4,323	0.1%	-14.6%
NY-F (Capital)	-	-	4,436	-	-	-	-	-	121	4,557	0.8%	-35.3%
NY-GHI (Southeast)	-	-	6,453	-	-	-	-	-	507	6,961	1.5%	589.7%
NY-J (NY City)	-	-	10,442	-	-	-	-	-	-	10,442	0.3%	-7.5%
NY-K (Long Island)	-	-	5,942	-	-	1	1	-	729	6,673	0.1%	-0.9%
2022 Total All Zones	-	-	31,501	1,580	-	2	0	-	2,822	35,905	0.5%	-4.0%
NY-AB (West)	-	-	686	1,244	-	-	-	-	763	2,692	0.0%	-56.9%
NY-CDE (Cent North)	-	-	3,204	336	-	-	-	-	702	4,242	0.0%	-16.2%
NY-F (Capital)	-	-	4,386	-	-	-	-	-	121	4,507	1.2%	-36.0%
NY-GHI (Southeast)	-	-	6,369	-	-	-	-	-	507	6,877	1.3%	581.3%
NY-J (NY City)	-	-	10,960	-	-	-	-	-	-	10,960	0.4%	-2.9%
NY-K (Long Island)	-	-	5,896	-	-	2	0	-	729	6,627	0.1%	-1.6%
2023 Total All Zones	-	-	31,518	1,682	-	3	1	-	2,886	36,090	0.5%	-3.5%
NY-AB (West)	-	-	682	1,342	-	-	-	-	763	2,787	0.0%	-55.4%
NY-CDE (Cent North)	-	-	3,171	340	-	-	-	-	766	4,277	0.1%	-15.5%
NY-F (Capital)	-	-	4,387	-	-	-	-	-	121	4,508	1.4%	-36.0%
NY-GHI (Southeast)	-	-	6,387	-	-	-	-	-	507	6,895	0.8%	583.1%
NY-J (NY City)	-	-	10,984	-	-	-	-	-	-	10,984	0.4%	-2.7%
NY-K (Long Island)	-	-	5,907	-	-	3	1	-	729	6,640	0.1%	-1.4%
2024 Total All Zones	-	-	31,540	1,850	-	1	0	-	2,897	36,288	0.4%	-2.9%
NY-AB (West)	-	-	683	1,502	-	-	-	-	763	2,948	0.0%	-52.8%
NY-CDE (Cent North)	-	-	3,165	349	-	-	-	-	773	4,287	0.1%	-15.3%
NY-F (Capital)	-	-	4,159	-	-	-	-	-	121	4,280	0.4%	-39.3%
NY-GHI (Southeast)	-	-	6,204	-	-	-	-	-	508	6,713	0.8%	565.1%
NY-J (NY City)	-	-	10,816	-	-	-	-	-	-	10,816	0.6%	-4.2%
NY-K (Long Island)	-	-	6,513	-	-	1	0	-	731	7,244	0.1%	7.6%
2025 Total All Zones	-	-	31,996	1,700	-	0	-	-	3,015	36,711	0.5%	-1.8%
NY-AB (West)	-	-	676	1,359	-	-	-	-	756	2,790	0.0%	-55.4%
NY-CDE (Cent North)	-	-	3,095	342	-	-	-	-	902	4,339	0.1%	-14.3%
NY-F (Capital)	-	-	3,785	-	-	-	-	-	121	3,907	0.6%	-44.6%
NY-GHI (Southeast)	-	-	5,906	-	-	-	-	-	507	6,413	1.1%	535.4%
NY-J (NY City)	-	-	11,344	-	-	-	-	-	-	11,344	0.6%	0.5%
NY-K (Long Island)	-	-	7,190	-	-	0	-	-	729	7,919	0.2%	17.6%

CO2 '000 metric tones	% Change from Sc. 1	% Change from 2015 this Scenario

CO2 '000 metric tones

Scenario 34 - IPEC 2 Seq. Years H	Nuclear	Hydro&PS	NatGas	Coal	Oil 6	Oil 2	Ker	Wind	Other (Wood, Refuse, Bio, PV,	Total	% Change from Sc. 1	% Change from 2015 this Scenario
2015 Total All Zones	-	-	27,066	4,607	-	3	0	-	2,782	34,458	-7.8%	0.0%
NY-AB (West)	-	-	813	4,184	-	-	-	-	761	5,758	-7.8%	0.0%
NY-CDE (Cent North)	-	-	3,723	423	-	-	-	-	671	4,817	-4.8%	0.0%
NY-F (Capital)	-	-	6,438	-	-	-	-	-	114	6,552	-7.0%	0.0%
NY-GHI (Southeast)	-	-	274	-	-	-	-	-	507	782	-22.5%	0.0%
NY-J (NY City)	-	-	10,234	-	-	-	-	-	-	10,234	-9.3%	0.0%
NY-K (Long Island)	-	-	5,583	-	-	3	0	-	729	6,315	-6.2%	0.0%
2016 Total All Zones	-	-	29,828	474	-	16	2	-	2,799	33,119	-13.3%	-3.9%
NY-AB (West)	-	-	888	51	-	-	-	-	769	1,708	-70.8%	-70.3%
NY-CDE (Cent North)	-	-	3,850	423	-	-	-	-	676	4,949	-0.3%	2.7%
NY-F (Capital)	-	-	6,613	-	-	-	-	-	114	6,727	-3.0%	2.7%
NY-GHI (Southeast)	-	-	1,753	-	-	0	-	-	509	2,262	3.1%	189.3%
NY-J (NY City)	-	-	11,024	-	-	1	-	-	-	11,025	-4.2%	7.7%
NY-K (Long Island)	-	-	5,700	-	-	15	2	-	731	6,447	-4.3%	2.1%
2017 Total All Zones	-	-	30,938	473	4	7	1	-	2,799	34,222	-8.6%	-0.7%
NY-AB (West)	-	-	887	48	-	-	-	-	771	1,706	-68.6%	-70.4%
NY-CDE (Cent North)	-	-	3,866	425	4	-	-	-	677	4,973	3.5%	3.2%
NY-F (Capital)	-	-	6,637	-	-	-	-	-	114	6,751	3.9%	3.0%
NY-GHI (Southeast)	-	-	2,409	-	-	0	-	-	508	2,917	7.0%	273.1%
NY-J (NY City)	-	-	11,514	-	-	0	-	-	-	11,514	0.4%	12.5%
NY-K (Long Island)	-	-	5,625	-	-	6	1	-	729	6,362	-2.1%	0.7%
2018 Total All Zones	-	-	28,611	416	-	2	0	-	2,784	31,813	-8.7%	-7.7%
NY-AB (West)	-	-	754	22	-	-	-	-	759	1,535	-62.2%	-73.3%
NY-CDE (Cent North)	-	-	3,395	394	-	-	-	-	674	4,462	0.6%	-7.4%
NY-F (Capital)	-	-	4,926	-	-	-	-	-	114	5,040	-0.9%	-23.1%
NY-GHI (Southeast)	-	-	4,590	-	-	-	-	-	508	5,098	2.6%	552.0%
NY-J (NY City)	-	-	9,798	-	-	-	-	-	-	9,798	-3.2%	-4.3%
NY-K (Long Island)	-	-	5,148	-	-	2	0	-	729	5,879	-4.6%	-6.9%
2019 Total All Zones	-	-	26,033	398	-	1	-	-	2,790	29,222	-15.9%	-15.2%
NY-AB (West)	-	-	715	15	-	-	-	-	762	1,492	-63.8%	-74.1%
NY-CDE (Cent North)	-	-	3,240	383	-	-	-	-	677	4,301	-3.6%	-10.7%
NY-F (Capital)	-	-	4,014	-	-	-	-	-	114	4,128	-15.6%	-37.0%
NY-GHI (Southeast)	-	-	4,048	-	-	-	-	-	508	4,556	-8.5%	482.7%
NY-J (NY City)	-	-	8,967	-	-	-	-	-	-	8,967	-11.0%	-12.4%
NY-K (Long Island)	-	-	5,049	-	-	1	-	-	729	5,779	-7.0%	-8.5%
2020 Total All Zones	-	-	26,574	337	-	1	-	-	2,787	29,699	-15.0%	-13.8%
NY-AB (West)	-	-	695	-	-	-	-	-	755	1,450	-54.8%	-74.8%
NY-CDE (Cent North)	-	-	3,161	337	-	-	-	-	679	4,177	-4.4%	-13.3%
NY-F (Capital)	-	-	3,889	-	-	-	-	-	114	4,003	-20.9%	-38.9%
NY-GHI (Southeast)	-	-	4,829	-	-	-	-	-	508	5,337	-10.2%	582.6%
NY-J (NY City)	-	-	8,993	-	-	-	-	-	-	8,993	-11.8%	-12.1%
NY-K (Long Island)	-	-	5,008	-	-	1	-	-	731	5,740	-6.9%	-9.1%
2021 Total All Zones	-	-	27,452	330	-	1	0	-	2,802	30,585	-14.7%	-11.2%
NY-AB (West)	-	-	683	-	-	-	-	-	754	1,437	-53.5%	-75.1%
NY-CDE (Cent North)	-	-	3,092	330	-	-	-	-	692	4,114	-4.8%	-14.6%
NY-F (Capital)	-	-	3,516	-	-	-	-	-	120	3,636	-19.6%	-44.5%
NY-GHI (Southeast)	-	-	5,533	-	-	-	-	-	507	6,039	-12.0%	672.5%
NY-J (NY City)	-	-	9,125	-	-	-	-	-	-	9,125	-12.3%	-10.8%
NY-K (Long Island)	-	-	5,504	-	-	1	0	-	729	6,234	-6.5%	-1.3%
2022 Total All Zones	-	-	27,170	313	-	1	-	-	2,800	30,283	-15.2%	-12.1%
NY-AB (West)	-	-	660	-	-	-	-	-	748	1,409	-47.7%	-75.5%
NY-CDE (Cent North)	-	-	3,006	313	-	-	-	-	695	4,014	-5.4%	-16.7%
NY-F (Capital)	-	-	3,250	-	-	-	-	-	121	3,370	-24.3%	-48.6%
NY-GHI (Southeast)	-	-	5,277	-	-	-	-	-	507	5,784	-14.8%	639.8%
NY-J (NY City)	-	-	9,508	-	-	-	-	-	-	9,508	-12.9%	-7.1%
NY-K (Long Island)	-	-	5,469	-	-	1	-	-	729	6,199	-6.4%	-1.8%
2023 Total All Zones	-	-	26,908	316	-	1	0	-	2,855	30,079	-16.2%	-12.7%
NY-AB (West)	-	-	656	-	-	-	-	-	744	1,400	-49.8%	-75.7%
NY-CDE (Cent North)	-	-	2,964	316	-	-	-	-	755	4,035	-5.6%	-16.2%
NY-F (Capital)	-	-	3,126	-	-	-	-	-	121	3,247	-26.9%	-50.4%
NY-GHI (Southeast)	-	-	5,295	-	-	-	-	-	506	5,801	-15.2%	642.0%
NY-J (NY City)	-	-	9,412	-	-	-	-	-	-	9,412	-13.9%	-8.0%
NY-K (Long Island)	-	-	5,454	-	-	1	0	-	729	6,184	-6.7%	-2.1%
2024 Total All Zones	-	-	26,697	321	-	-	-	-	2,855	29,873	-17.3%	-13.3%
NY-AB (West)	-	-	655	-	-	-	-	-	739	1,394	-52.7%	-75.8%
NY-CDE (Cent North)	-	-	2,928	321	-	-	-	-	757	4,007	-6.4%	-16.8%
NY-F (Capital)	-	-	3,129	-	-	-	-	-	121	3,250	-23.7%	-50.4%
NY-GHI (Southeast)	-	-	4,981	-	-	-	-	-	507	5,488	-17.6%	602.0%
NY-J (NY City)	-	-	8,991	-	-	-	-	-	-	8,991	-16.4%	-12.1%
NY-K (Long Island)	-	-	6,013	-	-	-	-	-	731	6,744	-6.8%	6.8%
2025 Total All Zones	-	-	26,915	312	-	-	-	-	2,958	30,185	-17.4%	-12.4%
NY-AB (West)	-	-	646	-	-	-	-	-	730	1,377	-50.6%	-76.1%
NY-CDE (Cent North)	-	-	2,892	312	-	-	-	-	872	4,076	-5.9%	-15.4%
NY-F (Capital)	-	-	2,799	-	-	-	-	-	121	2,919	-24.8%	-55.4%
NY-GHI (Southeast)	-	-	4,525	-	-	-	-	-	505	5,031	-20.7%	543.5%
NY-J (NY City)	-	-	9,371	-	-	-	-	-	-	9,371	-16.9%	-8.4%
NY-K (Long Island)	-	-	6,683	-	-	-	-	-	729	7,412	-6.2%	17.4%