NEW YORK STATE
PUBLIC SERVICE COMMISSION

Case 15-E-0302 – Proceeding on Motion of the Commission to Implement a Large-Scale Renewable Program and Clean Energy Standard

COMMENTS BY RICHARD ELLENBOGEN ON UTILITY SYSTEM DECARBONIZATION USING EXISTING TECHNOLOGIES

February 16, 2025

ABOUT THE AUTHOR

Richard Ellenbogen an active party in the case, a resident of the State of New York, the CEO of Allied Converters, and welcomes the opportunity to provide comments as requested by the Commission in the above referenced proceeding, issued in the May 18, 2023 "Order Initiating Process Regarding Zero Target".

I am a Former Bell Labs Engineer that has done work on the Utility System with NYSERDA and Con Ed. I also decarbonized my factory starting in 1999 and those measurements resulted in the Public Service Commissions Case 08-E-0751 to reduce power line losses. I was an invited speaker to a PSC Utility Conference in 2008 for that case on Line Loss Reduction that was initiated by Steven Keller based upon my work at the factory and a paper written at the request of Con Ed after a factory visit1. I was the Keynote Speaker at the 2023 Business Council of NY Renewable Energy Conference2 and an invited speaker at the Dutchess County Chamber of Commerce meeting on Energy. I was an early adopter of renewable technologies going back to the 1990's and decarbonized both my home and my business two decades ago. Between 2006 and mid 2023, the business recycled or repurposed 100% of its waste and sent nothing to a landfill. Over the past 20 years, the factory has generated between 60% and 85% of its electrical energy onsite with a carbon footprint approximately 30% lower than the Con Ed System, even prior to the closing of Indian Point.

SYSTEM WIDE DECARBONIZATION USING EXISTING TECHNOLOGIES

The following document builds upon the prior 15-E-0302 filings of February 18, 2024 "Is There a Viable Plan B" and the Ellenbogen and Caiazza filing of February 13, 2025 that documented the shortcomings and hazards of Lithium-Ion Battery Storage. Flaws in the logic of the existing CLCPA plan were documented in the earlier Ellenbogen filing of August 12, 2023. In contrast, a viable plan for the decarbonization of the downstate system, starting with Long Island, will be presented along with justifications for the technologies and relative prices compared to other solutions planned for, tried, or implemented by the state.

The five major shortcomings of the CLCPA that were presented in the 2023 document were as follows:

1 – There is a lack of available energy to support the Plan

2 – Costs to implement the Plan will far exceed other, better solutions
These costs accrue based upon shortages of materials and skilled labor, high energy storage costs, and a lack of financial adequacy

3 – Atmospheric Carbon Levels will rise far above what could be achieved using other alternatives

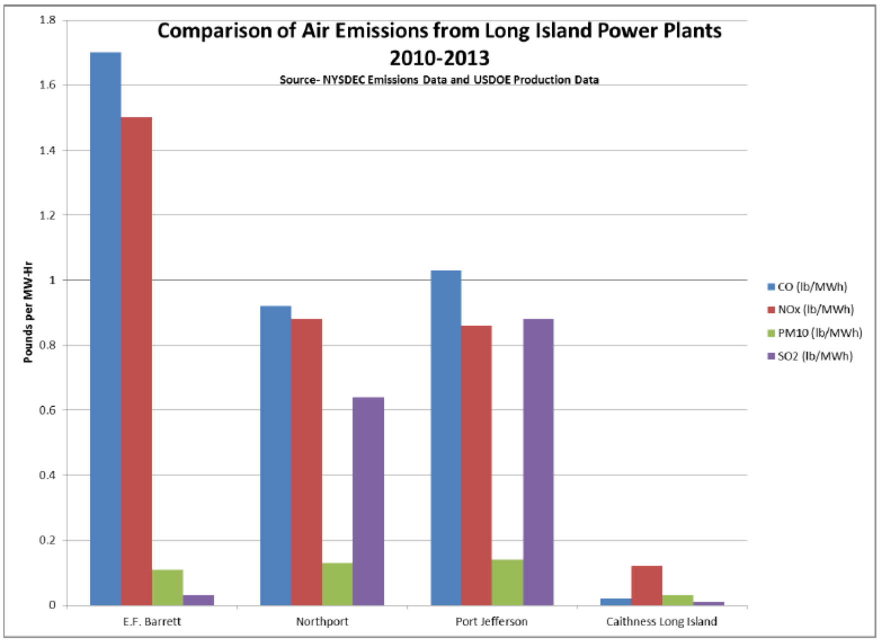
4 – Planned timing mandates are unachievable

5- There are major non-sequiter issues contained within the CLCPA

The filing from February, 2024 showed the cost comparisons between various types of generation. With the exception of Hydro-Power which is not easily expandable in NY State, natural gas generation is the most cost effective energy source. As utility bills in NY State have become a critical issue with approximately 1.3 million ratepayers in arrears, energy costs are an important consideration. Additionally, the CLCPA has prevented retooling of the three older Long Island Generating plants, E F Barrett, Northport, and Port Jefferson. There was an idea that the generation from these plants would be replaced by Off Shore Wind however that is not going to happen. The wind projects have been endangered since the initial concept was proposed. First, there were not the necessary Jones Act compliant ships needed to install the Wind Farms. Then supply chain difficulties and inflation drove up the costs so that the energy bids reached a level of $155 per MWh, three times the current cost of energy in NY State. The combined issues induced several offshore wind companies to abandon the US market even before President Trump banned new off shore wind installations. The entire concept was flawed from the planning stages because even had they been built, they would not have been able to support the summer peak loads as wind speeds off the coast of Long Island are lowest during the summer months. The CLCPA is a plan based upon ideology, not science or utility engineering.

The newest of the three conventional Long Island fossil fuel plants has sections that date to the 1970's as well as older sections. All three are based upon 50–70 year old technology and the negative impacts of that excessive age are apparent. Figure 1 shows the comparative emissions from the three plants, along with the Caithness plant, a combined cycle plant that opened in 2008. The differences in emissions are stark and efforts were made to retool the plants over seven years ago. Note that the Blue bars are Carbon Monoxide, not Carbon Dioxide.

Figure 1 Comparison of Emissions from Long Island Power Plants



As mentioned in the February, 2024 filing, replacing the three older plants would reduce natural gas usage related to those plants by 30% to 40% along with a comparative drop in CO_2 emissions and the reduction of pollutants shown in the graph in Figure 1. However, there is a way to reduce the GHG emissions related to these plants by 90% when compared to the three existing plants. The retooling of those three plants along with building Caithness II which was proposed but which apparently failed due to antitrust issues and not infrastructure issues (link follows) could add 4 Gigawatts of 90% carbon free generation to the downstate system where it is severely needed.
https://casetext.com/case/caithness-long-island-ii-llc-v-pseg-long-island-llc

The 4 Gigawatts of generation could add 30,000 GWh to the downstate system with a capacity factor of 85%.

There are solvent Scrubbing technologies available for CO_2 removal at utility scale to nearly fully decarbonize the combined cycle plants. A facility to capture 4000 Tons per day from a 500 MW combined cycle plant would have a footprint of approximately 2.75 acres including the gas compression equipment. An image of a solvent scrubbing facility appears in Figure 2. The CO_2 Process Flow Diagram appears in Figure 3 and an image of a 2,060 Megawatt plant with carbon capture presently being built in West Virginia appears in Figure 4. Table 1 shows the additional area required to add a CO_2 Scrubber plant to a Combined Cycle Generating Facility.

Figure 2 Image of a Solvent scrubbing facility (Courtesy of Babcock and Wilcox)

Figure 3 Solvent Scrubbing Process Flow Diagram (Courtesy of Babcock and Wilcox)

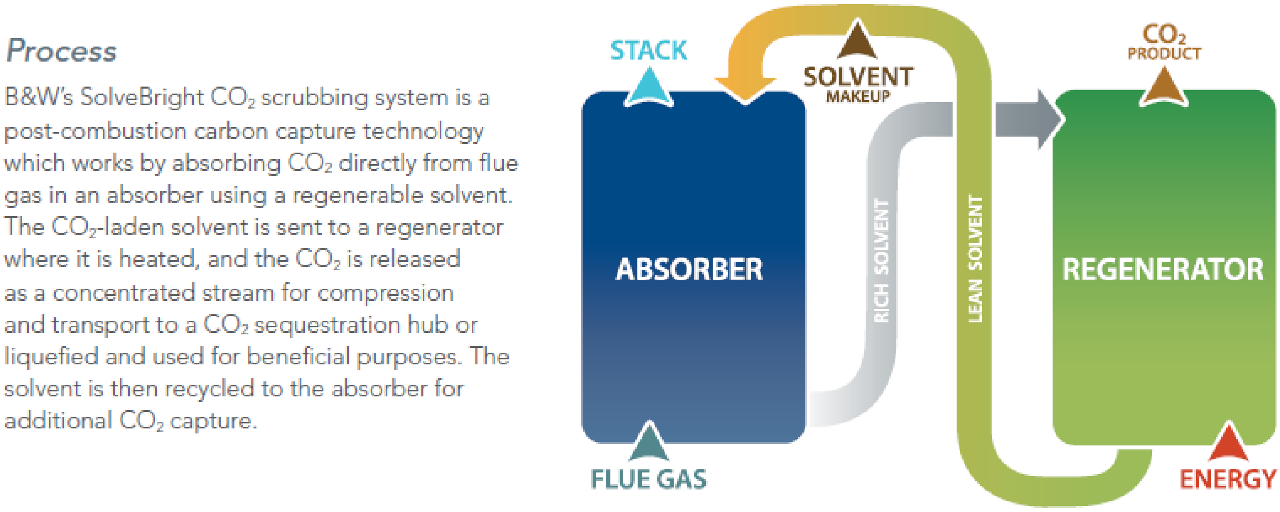


Figure 4 Image of a 2,060 MW Combined Cycle Generating Facility with Carbon Capture presently being built in West Virginia

Table 1 – Area Required For CO2 Scrubber Plants (Does not include Generation)

GENERATING PLANT CAPACITY (MW)	APPROX CO2 OUTPUT TONS PER DAY	SCRUBBER PLANT AREA With Compressors
12	100	0.6 Acres
180	1500	2.31 Acres
500	4180	3.76 Acres

The CLCPA had a fudge factor added to it to support the utility system during times of low sun and wind called the Dispatchable Emission Free Resource or DEFR. Unfortunately, during a Public Service Commission Conference at the end of 2023, no viable generation source was found other than nuclear that would fulfill the requirements for the DEFR. Nuclear Generation takes decades to approve, site, and build and according to the NYISO, NY State will be suffering from an energy shortage in 2033 and possibly as early as 2026, well before nuclear generation can be built. See the following link.
https://www.nyiso.com/-/press-release-nyiso-report-on-grid-reliability-finds-future-nyc-deficiency-increasing-statewide-concerns

In contrast, the carbon capture technology exists at present and at utility scale. The technical challenge is not the generation or the carbon capture. The only technical issue regarding this concept is how to sequester the thousands of tons of CO2 that will be captured every day as shown in Table 1. 4 GW (4000 MW) of combined cycle generation will yield almost 35,000 tons of CO2 daily using an average of 800 pounds of CO2 per MWh.

4000 MWh x 800 pounds x 24 hours / 2203 (pounds/MT)= 34,861 MT per day

The following sections will discuss the methods that can be used to overcome that challenge, the costs of the entire process, and the requirements for implementing the plan.

CARBON SEQUESTRATION AND ENSURING LONG ISLAND WATER QUALITY

The combined cycle plant with carbon capture currently being built in West Virginia has advantages over any that would be built in NY State. The geology of West Virginia is more amenable to deep well carbon sequestration on land. Long Island has a history of drinking water issues. As can be seen in the following links, those date to at least the 1970's when phosphates from detergents appeared in the drinking water in Suffolk County and even now when PFAS is present in the water supply.

https://www.nytimes.com/1970/11/13/archives/science-sewers-and-soap.html

https://longisland.news12.com/toxic-forever-chemicals-called-pfas-detected-in-dozens-of-li-water-districts

While CO2 entering the water supply would not present the same health hazard as phosphates or PFAS, the residents of Long Island don't need their kitchen faucets dispensing Club Soda. Further, CO2 leakage defeats the purpose of sequestration. As such, great care should be taken when sequestering the CO2. Fortunately, a large amount of research exists on this topic and there are areas in the ocean off of the coast of Long Island that should be suitable for that purpose. Basalt and other geologic formations in the ocean near Long Island will likely be a long term solution for CO2 Sequestration without causing ocean acidification. According to the following USGS link, the Atlantic Coastal Plain can sequester 14 Gigatons of CO2. That is 1,100 years at 35,000 tons per day so if even a fraction of that is available to this project, there is more than enough sequestration capacity to support this concept for the lifetime of these plants until a new technology is developed by 2090.

https://energy.usgs.gov/co2public/

More information on carbon sequestration can be found at the following links:

https://enews.lbl.gov/Science-Articles/Archive/sea-carb-bish.html

https://www.pnas.org/doi/10.1073/pnas.0804397105

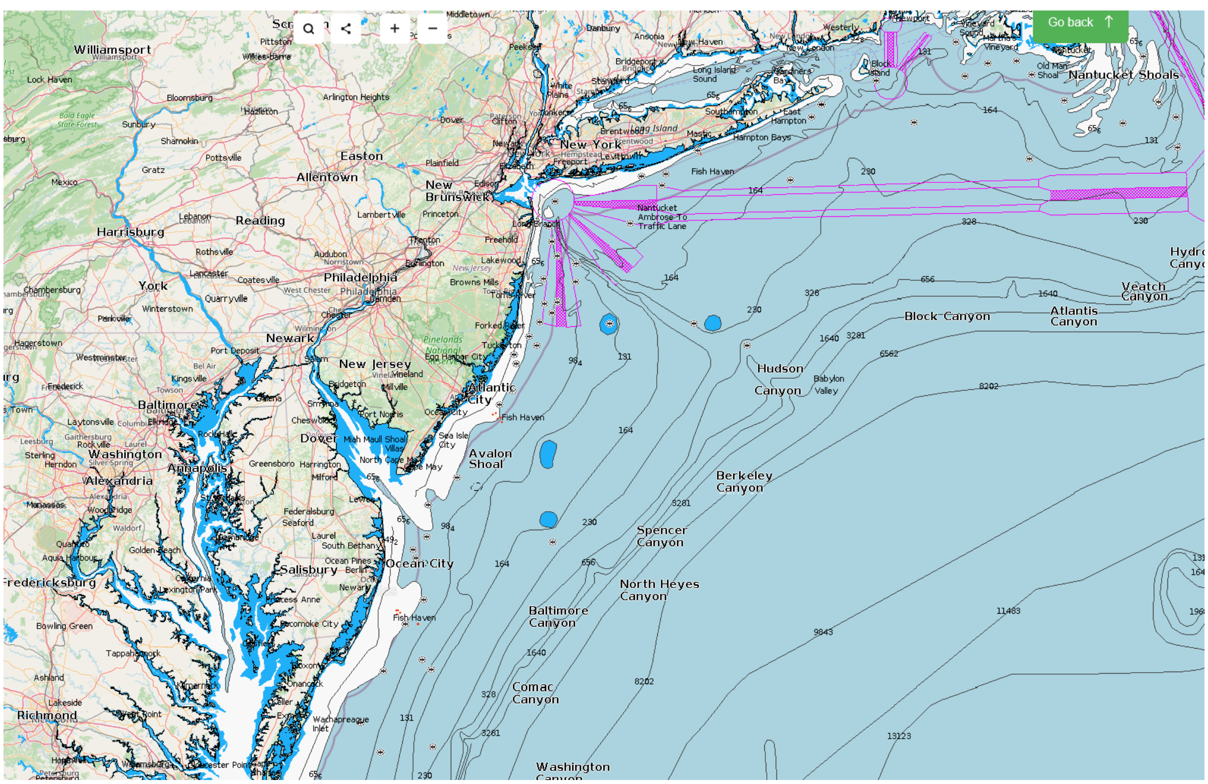
https://sccs.stanford.edu/sites/g/files/sbiybj17761/files/media/file/1-s2.0-s1750583617306709-main_0.pdf

INSTALLATION COSTS

The costs for this process will not ne inexpensive, however comparisons to the alternatives have to be considered prior to discarding the ideas because the alternatives that the state is currently considering are far more expensive and will provide less reliable energy.

Every 500 Megawatts of generation would result in an 18” diameter high pressure pipe containing CO2. 4 GW would result in four 26” diameter pipes of CO2 that would have to be sequestered. By drilling a few deep wells to a depth of about 7,000 to 10,000 feet below the ocean floor, all of the CO2 from the power generation could be sequestered. The drilling rigs would be similar to those used in the offshore oil industry, so the drilling technology exists. While the drilling rigs can be tall, there would only be four to eight of them for the entire project. They would be far enough from the shore so as to not be visible from land. In figure 5 below,

Figure 5 - Ocean Depths off the Coast of Long Island



the water depths on the Atlantic Coastal Plain mentioned as a possible site for sequestration are between 150 feet and 300 feet which would use less expensive drilling equipment and would be about 20 miles from the coast. Depending on the depth of the water, the cost would be between $400 million and $800 million per drilling rig. In the worst case scenario, the drilling would cost between $4 billion and $6 billion for the sequestration wells. A link to offshore drilling costs follows and Figure 5 shows the ocean depths off of the coast of Long Island.

https://shuntool.com/article/how-much-do-offshore-drilling-rigs-cost

The question then becomes the most effective way to transfer CO2 from the onshore plants to the offshore wells. Pipelines would seem to be the most effective way to do that and all of the existing generating sites are located near the coastline so pipes wouldn't necessarily need to cross near many residential properties. A second alternative would be transferring the CO2 via ship to the offshore wells, however that would require Jones Act compliant ships and based upon the issues with sending domestic natural gas to Puerto Rico in 2017, there are not many Jones Act compliant tank ships available. As of 2019, there were only two Jones Act compliant LNG tankers which is the same technology that would be needed for CO2 transfer.
https://www.cato.org/blog/needed-straight-talk-jones-act-lng

As of 2017, there were over 5,000 miles of CO2 pipelines in the United States, although finding costs for offshore CO2 pipelines is difficult. According to an American Petroleum Institute analysis of pipeline costs through 2035, offshore natural gas pipelines, a similar technology to CO2 transfer, would cost approximately $5.34 million per mile for a 30" diameter pipe. For this project, 26 inch diameter pipes would be used, each with a total distance of under 100 miles to maintain needed pressures. The following two links document pipeline costs in the petroleum industry.
https://www.gem.wiki/Oil_and_Gas_Pipeline_Construction_Costs

https://www.api.org/-/media/Files/Policy/Infrastructure/API-Infrastructure-Study-2017.pdf

The following link is to an article that discusses CO2 pipeline costs. Using the methodology in the paper, a 26 inch diameter onshore gas pipeline would have a cost of approximately $1.4 million per mile.

https://www.sciencedirect.com/science/article/pii/S1750583621001195

To avoid any surprises, a worst case scenario cost calculation should be used. If we nearly double the $5.34 million gas pipeline cost to $10 million per mile, seven times the onshore CO2 pipeline cost, and figure on 200 miles of pipeline for the four plants to transfer the CO2 to the offshore wells, we are left with a worst case scenario of $2 billion so the offshore CO2 sequestration will cost $8 billion at the high end of the estimates, including wells and pipelines.

The 2 GW West Virginia Combined cycle plant with carbon capture has a stated cost of $3 billion. If we double that because of the 4 GW capacity and then double that cost again because it is being built in NY State where everything is more expensive and it is also being built at multiple locations, the generation with carbon capture will have a high-end estimate of $12 billion, or $3 billion per GW, twice the cost of the West Virginia's plant cost of $1.5 billion per GW.

The total project cost for the 4 GW will have a high-end estimate of $20 billion for 90% carbon free generation. Unlike with the CLCPA, documentation has been provided to justify the cost estimates and nearly 100% cost overruns have been built into the numbers. There are several potential sources of savings that can be achieved in the process that may make the project far less expensive. First, the generation will be built on existing sites so there will be minimal costs for land acquisition, if any. The natural gas infrastructure already exists at all four sites as does the electric distribution infrastructure. It may have to be upgraded or refurbished, but that will not be nearly as expensive as building a generating plant on an entirely new site. Let's compare the $20 billion cost for this 4 GW plan to other alternatives being considered in NY State.

CHPE, the Champlain Hudson Power Express, has a cost of $6 billion to bring 1 GW of power to the downstate region and it is possible that it can be curtailed if Quebec has insufficient

Hydropower to export. Extrapolated to 4 GW, that totals $24 billion, $4 billion more than this proposal. It also will have taken 13 years to get it built from when it was first approved. The 1.1 GW Crickett Valley Combined Cycle plant built to offset the loss of energy from Indian Point was constructed in a fraction of that time. It was operating within 8 years of receiving the environmental permits in 2012 and that was for a generating plant on a new site, not retooled plants on existing sites where the new technology will actually improve the local environment.

While in the long term, upstate nuclear generation should be pursued, it will not be ready at a 4 GW capacity for at least 30 years. The recently completed Vogtle 3 and 4 plants cost in the range of $15 billion per GW. Assuming a 20% savings on building four of them, that yields $12 billion per GW or $48 billion for the 4 GW. The 4 GW of transmission lines would still be needed as the nuclear plants would have to be built upstate near Lake Ontario so the $48 billion for the generation plus the $24 billion for the cables results in a total cost of $72 billion. That is $52 billion more than this proposal. Additionally, the existing nuclear plants on Lake Ontario will be near their end of life in 30 years and that generation will have to be replaced.

To produce 30,000 GWh of energy annually, it would require 7.45 GW of offshore wind turbines with a capacity factor of 0.46.. From the following link, the cost per MW was 650,000 GBP for installation alone with a twenty-seven year lifespan. At present exchange rates, that is $812,000 per MW or $6 billion for 7.45 GW, not including the cost of ships needed. That is also the cost in the United Kingdom and costs in the US were nearly double those in Europe.

https://guidetoanoffshorewindfarm.com/wind-farm-costs

Energy costs from Offshore wind are substantially higher than the combined cycle plan which will be documented below plus the lifetime of the technology is half that of combined cycle plants so the installed costs of Offshore Wind over a 50 year lifetime of the technology could easily reach close to $20 billion. As the wind generation is intermittent, it would not have the same functionality as the Combined Cycle Generation in this plan unless battery storage was included and that will add enormous costs. Additionally, there are major recycling issues with wind turbine blades.

Beyond the installed cost, there is enormous resistance to offshore wind in local communities and it will not be a viable option as a generating source for at least four years because Trump has banned future development of offshore wind. That will push completion dates well beyond 2033 which is when the energy will be needed. Additionally, as mentioned previously, Offshore wind is at its nadir during the summer months so it will not support the system during the peak cooling season.

The recently troubled Cleanpath NY project had an $11 billion cost for 1.1 GW with a 60% capacity factor and about 8,000 GWh of energy annually. Extrapolated to 30,000 GWh, that is over a $41 billion cost, more than double the cost of this plan. That is in addition to the agitation caused to upstate residents from the siting of the renewable generation in their communities.

ENERGY COSTS

Energy costs in NY State are a critical issue. As of 2022, 1.2 million NY State ratepayers were $1.8 billion in arrears, an average of $1500 per delinquent ratepayer. Most of those were in the downstate region. In 2023, NY State provided $645 million in relief to help ratepayers with their utility bills. However, based upon 2024 NY State Senate legislation, the number of ratepayers now in arrears has risen to 1.3 million so the debt relief plan is not working.

Carbon emissions have a societal cost, however it is critical that any solutions to mitigating it don't destroy NY State resident's budgets or the state economy as a whole. Presently, the downstate region has some of the highest utility bills in the US and as was seen in the emissions graph for the Long Island Generating plants, they have some of the worst air quality to go along with the high costs.

To get a relative idea of energy costs for different generation types, Table 2 shows the 2023 costs for different types of generation in Ontario, Canada using current exchange rates of $0.75 US to $1.00 Canadian. A search was done for a similar breakdown of information from NY State and it was not found. There are some things to consider when viewing the numbers in the table. NY

State is the benefactor of inexpensive natural gas from Pennsylvania so natural gas generation is less expensive than what is in the table. Wind generation in the table is entirely land based and Offshore Wind bids in NY State were at $155 per MWh, three times the NY State average for electricity. Discussions with those familiar with the carbon capture technology when used with combined cycle generation have stated that the cost will be about $40 per megawatt-hour higher than without it resulting in a cost of about $90 per MWh or about $65 per MWh less than what NY State was willing to accept for its Offshore Wind bids. As the references for that $40 premium were a national average, the final costs of the carbon capture energy may not be much higher than what the residents in downstate NY are paying now.

TABLE 2 - 2023 Cost by Generation Source in Ontario, Canada

Generation Type	GWh	Cost (Millions) Canadian	Cost per MWh Canadian	Cost per MWh US
Nuclear	78765	$8,070.00	$102.00	$76.50
Hydro	37889	$2,396.00	$63.00	$47.25
Natural Gas	20630	$2,041.00	$99.00	$74.25
Wind	13810	$1,914.00	$138.00	$103.50
Solar	3784	$1,671.00	$441.00	$330.75
Biofuel	1103	$213.00	$193.00	$144.75

Utah recently abandoned its SMR (Small Modular Reactor) project because the costs for the energy were approximately $90 per MWh, or about the same as for the Combined Cycle Generation with Carbon Capture Technology. While $90 per MWh doesn't seem relatively expensive in NY State, it was very expensive when compared to Utah's generation mix. Additionally, the availability of firm generation in the downstate region will alleviate the immediate need for installing Lithium-ion batteries so that the state can wait until better and safer energy storage technologies are available. That is a cost offset for this project. With the high population density of the downstate region, there is no truly safe place to install a Li-ion BESS System in the NY City Metropolitan area or on Long Island.

Because of the onerous terms of the CLCPA, there is no viable energy source that will truly meet both the requirements of the law and the energy needs of the state. However, this idea comes the closest. There will inevitably be people that protest because it uses natural gas as an energy source, however it will use 40% less than what is currently being consumed plus it will greatly reduce NOx emissions that have a GHG footprint one hundred times higher than CO2 as is apparent from viewing Figure 1.

BENEFITS OF THIS PLAN

There are numerous benefits to this plan. The only question that remains is the amount of political willpower needed for proponents of the CLCPA to understand the realities of the Laws of Thermodynamics and the flaws in the existing plan.

The benefits of this plan are as follows.

1 – It follows the Laws of Thermodynamics. The energy calculations are mathematically sound. The energy calculations contained within the CLCPA are a fantasy and cannot be achieved as has become apparent over the past five years of continual project failures and cancellations since the CLCPA's inception.

2 – The retooled generating plants will provide dispatchable energy when it is needed and are not subject to changes in the weather.

3 - They will reduce natural gas usage 30% to 40% per MWh below current levels at those plants.

4 – As seen in Figure 1, comparing the Caithness Plant and the other Long Island Generating Plants, the retooled generation will have greatly reduced NOx, SOx, PM2.5 and PM10 emissions. NOx has a Carbon Equivalent Emission one hundred times that of CO2 and the higher SOx and particulate emissions are associated with asthma.

5 – The retooled generating plants will have GHG emissions 90% lower than the existing plants. That is true climate justice for residents near those plants. The expanded firm energy resource may also allow for the closing of the NY City peaker plants providing climate justice for those residents, as well.

6 - The retooled plants will be more reliable than 50-70 year old generating plants providing more security against blackouts.

7 – The Energy Costs are 40% less than that for Offshore Wind and at or below the current costs for utility scale solar

8 – Existing transmission capacity can be used at the sites of the existing plants as can the natural gas infrastructure. Because of the reduced gas usage of the retooled plants, they will free up natural gas capacity for other uses without adding pipeline capacity.

9 - Eliminates the immediate need for Lithium Ion Battery Storage until a more fundamentally safe energy storage technology can be implemented.

10 – It is the same type of energy generation that has existed at those sites for decades. The local communities are used to it. The newer plants will just be nearly emission free and improve the environment in the local communities. There won't be public resistance from trying to install new SMR nuclear technology, that while likely safe will engender fear in the local area.

11- Temporarily avoids the cost of building expensive transmission lines from upstate NewYork

12- The process can also be adapted to fill the 2 Gigawatt hole in the energy system that is about to form with the construction of Micron Technologies Chip Fab in Clay, NY. By building a similar plant onsite in Clay, Micron can take advantage of the thermal output of the combined cycle plants and become even more energy efficient. Suitability of the geology below that site for carbon capture would have to be determined, however NYSERDA has issued documents regarding Carbon Capture options in NY State. The technology has evolved since the studies were done but they are a good starting point.

https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Events/Events-and-Conferences/EMEP-2009/presentations/2009-Singer-presentation.pdf

https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Publications/Research/Environmental/Carbon-Sequestration-Feasibility-Study.pdf

13 - **THE TECHNOLOGIES EXIST NOW FOR CARBON CAPTURE AT UTILITY SCALE AND CAN BE IMPLEMENTED IN THE VERY NEAR FUTURE PENDING THE POLITICAL WILL POWER TO ACKNOWLEDGE THE FLAWS IN THE EXISTING PLAN**

- The Generation technology has been used for over twenty years
- The Drilling Technology is extremely well tested
- The Carbon Capture Equipment is being manufactured at Utility Scale TODAY.
- NY State will not need to wait several decades to make its electric power grid functional.

CONCLUSION

NY State is at a crossroads where its utility system has become extremely compromised and it is restricted by a law that has no scientific foundation as to viable solutions that can be implemented to provide a secure source of electric energy. That flaw presents a danger to NY State residents and to the NY State economy.

The above solution, while not "perfect" in the eyes of the CLCPA, is the closest that NY State will get to a viable solution prior to the lights going out in 2033, if not sooner. Plus, NY State owes it to the residents living near those plants to improve their air quality. The state had a chance to do so ten years ago when LIPA suggested it. Waiting for a miracle does not qualify as a plan. As the technology to do that is available at lower costs than what the state has been willing to pay for alternatives, the procrastination against improving those plants equates to negligence.

Additional research needs to be done to determine more precise cost estimates and to also find the optimal locations for the CO2 sequestration, however this document presents a good starting point using existing technologies for an environmentally sound project that will provide the state with enough energy. It is also more in keeping with energy sources that the public is used to and far more cost effective than the alternative solutions that have been presented over the past five years and that familiarity and cost effectiveness will be critical for public acceptance.