Case No. 19-E-0530
-Via Electronic Filing-

Hon. Kathleen H. Burgess
Secretary to the Commission
New York State Public Service Commission
Three Empire State Plaza
Albany, New York 12223-1350

Re: Proceeding on Motion of the Commission to Consider Resource Adequacy Matters

Dear Secretary Burgess,

I am writing in response to the request for comments regarding resource adequacy matters docket Case 19-E-0530. I am writing to express my concerns regarding the Commission's statutory obligations to ensure the provision of safe and adequate service at just and reasonable rates. While costs to consumers are a primary and ultimate consideration, current New York State policy also has to be evaluated with regards to feasibility and cumulative environmental impacts in order to determine whether safe and adequate service is possible.

I am submitting these comments as a citizen scientist. Before I retired, I worked in the electric generating sector but the opinions expressed in these comments do not reflect the position of any of my previous employers or any other company I have been associated with, these comments are mine alone.

The DPS August 8, 2019 order instituting the proceeding and soliciting comments included question (6) "What is the State role with respect to resource adequacy matters that best serves New York's electricity customers with safe, adequate, and reliable service at just and reasonable rates in the context of state policies?". My comments primarily address this question.

On July 18, 2019 New York Governor Andrew Cuomo signed the Climate Leadership and Community Protection Act (CLCPA), which establishes targets for decreasing greenhouse gas emissions, increasing renewable electricity production, and improving energy efficiency. Unfortunately, the legislation's aspirational renewable electricity goals were not developed based on any feasibility studies. The fact is that no jurisdiction has successfully implemented an electricity system with zero GHG emissions. In order to determine if electricity customers can continue to receive safe, adequate and reliable service the State has to do a feasibility study considering the state-specific reliability requirements of the State in general and New York City in particular. It will only be possible to determine if the State can continue to have just and reasonable rates once a resource adequacy feasibility study is complete. I have prepared an

example of the feasibility study that I think is necessary in the attached White Paper entitled Initial Estimate of Energy Storage Required for Climate Leadership and Community Protection Act Solar and Wind Resources, (Hereinafter the "White Paper").

One of the big implementation issues for renewable energy is that it is intermittent. The resource adequacy feasibility study has to specifically address energy storage requirements. How much will be needed and where does it have to be located to provide reliable power to the State as a whole and New York City in particular. It should to without saying that no plan that endangers the reliability of electricity in New York City is acceptable.

There is one other component regarding the resource adequacy process. While individual renewable energy facilities may not have an unacceptable negative environmental impact, the cumulative environmental impacts of all the resources necessary to supply adequate energy might have significant environmental impacts. Therefore, I recommend that this resource adequacy proceeding consider cumulative environmental impacts of the CLCPA.

Feasibility Analysis

New York's CLCPA future electric system is going to be utterly dependent upon intermittent and diffuse renewable energy. In order to determine the limitations of intermittency, a detailed analysis of solar and wind resource availability based on real-world data is necessary. Because renewable energy is diffuse considerations of the amount of space, where it will likely be sited, and transmission requirements are also necessary.

One potential approach to renewable resource availability is to over-build wind and solar facilities. For example, Dr. Richard Perez at SUNY Albany recommends "oversizing and proactively curtailing wind and solar" resources. However, the attached White Paper shows that adding New York solar and wind capacity increases overall production and production peaks but does not increase output nearly as much during production valleys. Intuitively, it seems that no amount of additional solar capacity will help during a light wind night and the White Paper confirms it. While some may argue that increased transmission capacity to a location where the winds are not light might solve the problem that is a non-starter for New York State given the reliability requirements for in-city generation of power in New York City.

There is another related consideration in this regard. Because there will always be periods when no amount of renewable energy can make up the difference energy storage will be required. The question is how much. Furthermore, in order to meet CLCPA goals winter heating has to be electrified. I believe that the winter peak will be the future resource adequacy issue because the solar resource is lower than in the summer. Moreover, home-heating electrification has a deeper problem. The preferred approach is to use heat pumps but ground source heat pumps are

expensive to retrofit so air source heat pumps will likely be used more. Unfortunately, when the temperature is below zero air source heat pumps do not work so much less efficient radiant electric will have to be used to meet the GHG emission reduction goal. That will exacerbate the winter peak problem.

I strongly recommend that actual meteorological conditions be used in the feasibility assessment. Fortunately, the information necessary to do an adequate feasibility study is available. The NYS Mesonet is a network of 126 weather observing sites across New York State including at least one in each county. All the data necessary to completely characterize solar energy production are available from the Mesonet stations. Wind data are also available but I would not be surprised if there is another source of more representative wind resource data at the New York Independent System Operator.

I believe using actual short-term meteorological data is a particularly important requirement for New York in general and in areas Upstate downwind of the Great Lakes in particular. This is because the lakes create meso-scale features, most notably lake-effect snow, that can affect solar resources many miles from the lake shore. It is important that the solar and wind resources be evaluated based on short-term data so that site-specific temporal effects can be included.

The question that must be addressed is just how much energy any proposed facility can provide to the system and when it is provided. It is important to do this analysis with as much data as possible to determine the worst case. As shown in the White Paper actual meteorological data can be used to estimate solar and wind resources. The White Paper uses crude approximations of the relationship and the State's analysis should refine them. Results from this analysis will be needed to determine how much energy storage will be needed to prevent a reliability problem when the energy is needed the most. Failure to do so could literally result in people freezing to death in the dark.

In addition to the feasibility application of this report, another useful output would be to support Article Ten solar energy applications. The electric system production analyses for solar projects generally use a design year as input. The feasibility analysis could generate a more appropriate data set. No design year that relies on location and estimates of average cloud cover can adequately represent what actually is happening at Upstate NY locations affected by lake-effect clouds and snow.

Finally, the feasibility analysis could provide another state-wide benefit. The NYS mesonet is a great resource for real-time data. However due to funding limitations, the historical data archive is not easily accessible. In order to access data, it is necessary to submit a data request. In order to do the resource adequacy feasibility analysis, the historical data would have to be processed and

that could be used as the basis for a historical data archive that could be made available to the public without the need for manual intervention. I recommend that NYSERDA provide that historical data base for use in future planning and analysis.

Storage Requirements

In addition to the solar and wind resource feasibility study, detailed analysis of the energy storage requirements is needed to assure safe and adequate service. While the need to store energy for use when the sun isn't shining and wind isn't blowing is obvious there is another important application for energy storage. Because these renewable resources are diffuse, the transmission grid will still be needed and it must be stable for power supply reliability and security.

It is important to remember that electric power being put into the grid has to closely match what is taken out. A stable power system matches generation and load. It continuously responds and compensates for power/ frequency disturbances and compensates for those changes as needed. The electric system of the future will be different because the mix of alternating current machines used for the generation of electricity will change. There are two types of machines: synchronous and asynchronous. Fossil, nuclear and hydro are synchronous machines that generate electricity by spinning turbines and are controllable by governors which monitor system frequency and adjust prime mover input to bring correction to frequency movements. The kinetic energy of a synchronous machine is closely coupled to the power system and directly contributes to grid stability. The kinetic energy of an asynchronous machine is decoupled from the system so it does not directly contribute to grid stability. Wind turbines and solar panels are asynchronous generators. These generators cannot respond to frequency movements representing a system energy imbalance. They are instead a cause of energy imbalance.

Fortunately, battery energy storage is well suited to address the energy imbalance issue. The Rocky Mountain Institute study, The Economics of Battery Energy Storage, describes 12 services in addition to energy storage that battery energy storage can provide. However, the New York State resource feasibility study has to determine how this resource can be implemented to fulfill all the necessary requirements. For example, if an energy storage facility is providing frequency support it will not be available to provide storage for renewable resources because frequency support requires batteries to be charged at mid-load to react to surpluses and deficits while energy storage support requires the batteries to be charged as much as possible to provide the maximum duration of supply.

The importance of this concern is underscored by a couple of instances of blackouts associated with wind facilities: one in South Australia in 2016 and in one August 2019 in England. According to a Wikipedia 2016 South Australian blackout article severe weather damaged a section of the transmission system. In response to the damage automatic safety features kicked in but there was

an issue with four wind farms and they all shut down or reduced load so much that the system could not recover and a blackout ensued. According to the article "In 2019, the Australian Energy Regulator initiated proceedings in the Federal Court of Australia against the operators of four wind farms. It alleged that these companies had failed to comply with performance requirements to ride through major disruptions and disturbances.

On August 9, 2019 there was another incident in England. According to the preliminary National Grid report on the incident:

> At 4:52pm there was a lightning strike on a transmission circuit (the Eaton Socon – Wymondley Main). The protection systems operated and cleared the lightning in under 0.1 seconds. The line then returned to normal operation after c. 20 seconds. There was some loss of small embedded generation which was connected to the distribution system (c. 500MW) due to the lightning strike. All of this is normal and expected for a lightning strike on a transmission line.
>
> However, immediately following the lightning strike and within seconds of each other:
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> - Hornsea off-shore windfarm reduced its energy supply to the grid
> - Little Barford gas power station reduced its energy supply to the grid
>
> The total generation lost from these two transmission-connected generators was 1,378MW. This unexpected loss of generation meant that the frequency fell very quickly and went outside the normal range of 50.5Hz – 49.5Hz.
>
> The ESO was keeping 1,000MW of automatic "backup" power at that time – this level is what is required under the regulatory approved Security and Quality of Supply Standards (SQSS) and is designed to cover the loss of the single biggest generator to the grid.
>
> All the "backup power" and tools the ESO normally uses and had available to manage the frequency were used (this included 472MW of battery storage). However, the scale of generation loss meant that the frequency fell to a level (48.8Hz) where secondary backup systems were required to disconnect some demand (the Low Frequency Demand Disconnection scheme) and these automatically kicked in to recover the frequency and ensure the safety and integrity of the network

In order to insure a future safe and reliable grid the resource adequacy process must include an analysis to determine what standards and requirements are needed in New York for a stable grid to prevent a similar incident in the CLCPA future.

In addition, a specific analysis to determine the amount of energy storage to cover for solar and wind intermittency is needed. As shown in the White Paper example significant amounts of energy storage will be required to cover low wind and solar availability on calm nights. In the example shown 1,300 MW at 6-hour duration; 2,750 MW at 5-hour duration; 2,690 MW at 1-hour duration; 1,250 MW at 2-hour duration and another 620 MW at 1-hour duration. The total MWh stored (37,160) exceeds the observed total deficit (33,548) by 3,612. According to the energy benchmark costs in in a recently released report from the National Renewable Energy Lab (NREL): "2018 U.S. Utility-Scale Photovoltaics-Plus-Energy Storage System Cost Benchmark" the battery costs alone for the energy storage facilities in this example could cost $12.5 billion dollars for just the batteries required to replace existing fossil generation and Indian Point. The State needs to determine the worst-case storage deficit and develop an energy storage plan to meet this requirement. This is particularly important because energy storage is extraordinarily expensive and that could affect the Proceedings charge to provide just and reasonable rates.

The White Paper looked at a historical period and evaluated a renewable energy scenario to replace just fossil and Indian Point at current loads. As part of the energy storage analysis projections for future load are also required. In order to meet the state-wide CLCPA GHG emission reduction goals reductions from all sectors will be needed and one of the biggest remaining sectors is residential home heating. This will require electrification and the preferred clean energy alternative for home heating is electric heat pumps. Appendix 1 – Air Source Heat Pumps and Winter Peak Load describes a resource adequacy issue related to air source heat pumps illustrated by an example case study of heat pump energy supplied by solar and wind that underscores the importance of the State doing a similar analysis in more detail.

The Appendix 1 analysis raises the important point that while air source heat pumps are efficient for temperatures above 15 deg. F efficiency goes down rapidly for lower temperatures. Because the most likely backup heating source for air source heat pumps is much less efficient radiant heat the winter peak load requirement will be even higher. My example results show that a 180 MW solar farm and a 100 MW wind farm located near Rochester, NY could only be able to cover the conversion of 2,737 homes to air source heat pumps during the 2017-2018 winter peak. According to Patterns and Trends - New York State Energy Profiles: 2002-2016 there are over four million homes currently using utility gas, another million homes currently using fuel oil or kerosene, 500,000 homes using electricity and another 200,000 using propane in New York State. The potential electric load necessary to convert these households to reduce GHG emissions must be included in the States analysis of future loads and the resources necessary to meet those loads.

Cumulative Environmental Impacts

As far as I can tell the State Administrative Procedure Act (SAPA) and the State Environmental Quality Review Act (SEQRA) requirements for environmental reviews do not apply to the Climate

Leadership and Community Protection Act. The problem is that while an individual industrial wind facility or solar facility may not have a significant environmental impact the cumulative impact of all the facilities necessary to provide enough power to meet the reliability needs of the state could have significant environmental impacts.

The State policy for additional renewable energy encourages companies to develop plans and apply for permits for wind and solar projects. Many of those facilities will have to go through the DPS Article Ten permitting process. It is not efficient, equitable, or in the State's best interest if they want those facilities developed to require those applicants to assess potential cumulative impacts. Nonetheless there is a clear need to consider the cumulative impact problem. Therefore, I recommend that the resource adequacy feasibility study include a cumulative environmental impact statement.

Response to Selected Specific Questions

1) Are the State's energy policies and mandates, such as those related to Offshore Wind, photovoltaics, other renewables, and energy storage compatible with the NYISO's resource adequacy mechanisms? If not, what issues are manifested? Also, if not, how could they be aligned?

   The White Paper and Appendix 1 provide two examples of renewable potential resource estimates based on real world data to determine the renewable potential availability. To my knowledge NYISO resource adequacy mechanisms have not included the same kind of analysis. Because there are small spatial and temporal variations in solar and wind potential due to the effect of Lakes Ontario and Erie actual data must be used to determine if there will be adequate resources. In addition to the renewable resources the storage and grid support services need to be evaluated. All this can be addressed with an extensive feasibility study similar to the examples in these comments.

2) Does the interaction of policies and market structure mechanisms result in safe and adequate service at just and reasonable rates for customers?

   The Climate Leadership and Community Protection Act has been described as the "most aggressive climate law in the United States". While that aggression may serve the purposes of the politicians who approved this legislation well, the reality is that their goals and targets are unprecedented. As a result, I don't think anyone has any idea how the policies and market structure mechanisms will have to work to maintain safe and adequate services at just and reasonable rates for customers for the CLCPA future grid. The feasibility study that I have described above is a necessary first step to address this question.

   In order to insure just and reasonable rates I recommend that the Commission establish criteria for just and reasonable rates. There should be an energy poverty safety valve limit

established before any of these programs are implemented. The current status of the chosen metric should be established as part of this proceeding, the metric regularly updated, and the consequences of an exceedance of the metric promulgated so that just and reasonable rates are maintained.

New York City has well known particular safe and adequate service requirements. It is not clear that those requirements can be met with diffuse and intermittent renewable generation. Simply put, because there likely is not enough space within New York City to provide enough in-city generation at all times the question becomes how do you provide enough supply and still meet the in-city generation requirements. A primary aspect of my recommended feasibility study should be a focus on this particular aspect of the New York State electric energy system.

5) Should alternative approaches be considered to ensure the procurement of generation resources is aligned with State policy goals? If so, which ones? Are there existing or proposed models which might be instructive, such as the State overseeing LSEs' resource adequacy portfolios (e.g., an approach similar to the one used by California) or restructuring NYISO rules to accommodate State public policies (e.g., a Fixed Resource Requirement Alternative, as proposed by FERC Order issued on June 29, 2018 in Docket No. EL16-49, ¶160 et seq.)?

This is outside my area of expertise but I do think this proceeding should address the question how much energy storage is needed and where should it be located. Once that is known then an approach to ensure the procurement of energy storage resources to align with State policy goals has to be developed.

7) What, if any, next steps should the Commission take with respect to resource adequacy matters?

I have two study recommendations that I believe are needed to determine feasibility. I recommend that the Commission a study to provide a feasibility analysis using meteorological data from the NYS Mesonet to determine renewable of energy resource availability. The results from this study should be used to determine energy storage requirements for the CLCPA electric system future grid. In addition, I believe it would be appropriate for the Commission to do a cumulative environmental impact analysis for the projected renewable energy resources deemed necessary by the feasibility study. Both studies should be done in an open and transparent way with public opportunity to comment on methodology and results. All public comments should be addressed in a response to comments document.

Finally, I recommend that there be an independent review of the findings to preclude the possibility that the results could be influenced by political pressure. The CLCPA is

the product of NYS politicians. In 1981 politicians dictated energy policy in New York by passing the "six cent law". That legislation was derived in large part from the Public Utility Regulatory Policies Act of 1978 ("PURPA"), 16 U.S.C. § 2601 et seq., which Congress enacted "to promote long-term economic growth by reducing the nation's reliance on oil and gas, to encourage the development of alternative energy sources and thereby to combat a nationwide energy crisis". In my opinion that sounds pretty much like the basis for this law. That law required the PSC to establish a minimum sales price of at least six cents per kilowatt hour for power purchased from state qualifying cogeneration facilities. When the actual generation costs did not rise as predicted by the NY politicians, electric utilities ended up paying much more for the power than necessary. Not only did that hurt the utilities financial viability, the costs were passed on to consumers. If the feasibility studies come to the conclusion that the renewable energy and energy storage dictated by the CLCPA are unable to provide safe and adequate service at just and reasonable rates there will be enormous political pressure to revise the results. If the feasibility studies are done openly, comments are addressed, and an independent review of the findings is included, then there is a possibility that another legislative debacle could be averted before it causes economic damage to the state. It is very likely that the most vulnerable segments of society will be hurt the most. If the electrification of home heating and reliance on renewables is done wrong, there is a very real possibility that people will freeze to death in the dark.

Thank you for the opportunity to provide comments on this proceeding.

Sincerely,

Roger Caiazza
7679 Bay Cir
Liverpool, NY 13090