Climate Leadership and Community Protection Act Energy Planning 101

I prepared this documentation because I am very concerned about the impacts of the Climate Leadership and Community Protection Act (CLCPA) on energy system reliability and affordability. This document describes some fundamental energy planning concerns and summarizes my primary concern with CLCPA implementation, namely the adequacy of wind and solar during the winter peak load period when the heating and transportation sectors are electrified.

I am a retired electric utility meteorologist with nearly 40-years-experience analyzing the effects of meteorology on electric operations. I believe that gives me a unique background to evaluate the potential quantitative effects of energy policies to address climate change. The opinions expressed in this post 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.

Background Information

I am not aware of any basic summary of the power system that addresses all the issues that arise when variable generation resources like wind and solar make up a significant portion of the generation mix. I prepared this document to fulfill that purpose and highlight what I think is the biggest technical issue implementing the CLCPA - the peak load resource adequacy problem.

I summarize three blog posts on energy planning that give a very good overview of energy planning issues for an electric power generation and transmission system with the amounts of wind and solar resources envisioned for the CLCPA. The author wrote these posts to provoke thought and spur discussion to provide valuable background information. The author has a BSEE from The Ohio State University and a Masters of Electrical Engineering from University of Southern California. He worked in power generation and transmission for over 30 years for different sized utilities, participated and held leadership roles in various research groups and reliability organizations. He wrote under the pseudonym "Planning Engineer" because he wanted to frankly share his personal views and not have them tied directly to his current employer.

The post entitled "Transmission planning: wind and solar" discusses how the transmission system is impacted by renewable resources. Because wind and solar are diffuse, the transmission system is required to collect the energy and deliver it where it is needed. There are three major grids in the United States and Canada that have been constructed so that electricity serves load from "planned generation without overstressing any part of the system". The post shows that when you change generation resources to include renewables it stresses the grids, so adding the amount of variable wind and solar generation needed to meet the CLCPA targets means there is a problem that must be addressed. The post goes on to describe grid stability, how renewables affect stability, and the challenges of the proposed transition. Anyone unfamiliar with those terms is encouraged to read the post.

A second post, "All megawatts are not equal, explains that different types of generating resources bring different benefits to the electric system. There is a description of the long-term generation planning process that will be required to meet the CLCPA targets. In order to maintain reliability, there has to be enough generation capacity available to meet load demand when needed. The post goes on to explain the challenges of operating the system, the value of new systems to meeting load demand, and how wind and solar change traditional generation planning. The bottom line is that alternatives have to be developed over the long term.

The final post I want to highlight discusses the problem of balancing system loads and resources in a system impacted by wind and solar. The post describes the use of various types of generation in the traditional electric system and how operators, like the New York Independent System Operator, use those resources to provide electricity when and where needed. The difficulty that CLCPA implementation has to overcome is that intermittent wind and solar often do not produce peak power when the load peaks. The post shows that backup resources will be needed.

Resource Adequacy Problem

I believe that in order for the CLCPA to be successful it must not only provide the environmental benefits planned but preserve electric system reliability. Electric system reliability will have life and death consequences when heating and transportation are electrified. There are two aspects of the resource adequacy problem that CLCPA implementation must address: future load and renewable energy availability during peak load periods.

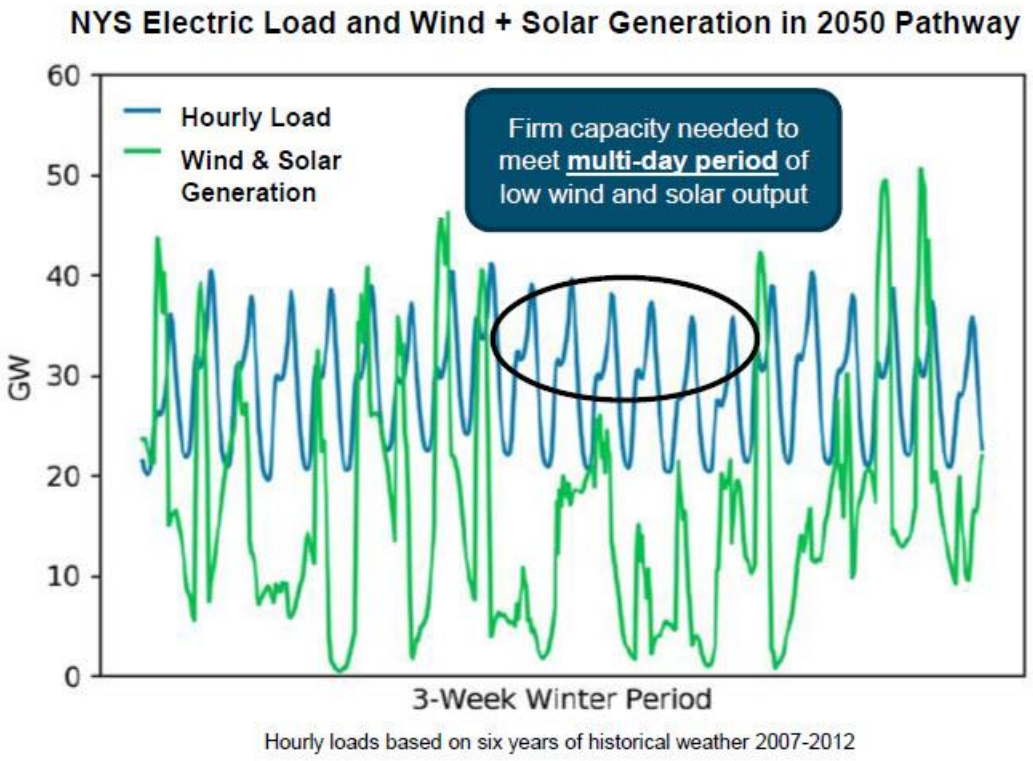
It is generally acknowledged that the future load peak will occur in the winter. Because both heating and transportation must be electrified to meet the emissions reduction targets in those sectors there will be a load peak shift from the summer to winter primarily because it takes more energy to heat than cool. When the electric load demand of the transportation sector is included it seems unlikely that energy efficiency will be able to prevent an increase from current levels.

The CLCPA plans to replace fossil generation with wind and solar energy. At Albany New York's latitude, day length is over six hours less at the winter solstice than the summer solstice and the sun angle is lower so the strength of the sunlight is less in winter too. Moreover, clouds are more frequent and lower so they are more opaque. Include the fact that solar panels could be covered with snow and that all means that in the worst-case, solar energy's contribution to the power needed could essentially be zero. Wind can also become calm during the winter albeit there is not the same seasonal difference as with solar. Therefore, it is important to determine the minimum availability of those resources.

In order to maintain reliability, we need resources that can replace the loss of intermittent wind and solar energy while at the same time it is likely that loads will increase. There has to be an alternative resource that can be dispatched to provide power to meet the load required to keep the lights on. Every member of the Climate Action Council, advisory panels and working groups should understand that this problem exists and the ramifications of this issue on the energy strategies they propose. Note that E3 and the Analysis Group have both recently raised this issue.

E3

In their presentation to the Power Generation Advisory Panel on September 16, 2020, E3 included a slide titled Electricity Supply – Firm Capacity. Consistent with the above, the slide states: "The need for dispatchable resources is most pronounced during winter periods of high demand for electrified heating and transportation and lower wind and solar output. In this instance they are equating firm capacity to a resource that can be dispatched whenever it is needed. The slide goes on to say: "As the share of intermittent resources like wind and solar grows substantially, some studies suggest that complementing with firm, zero emission resources, such as bioenergy, synthesized fuels such as hydrogen, hydropower, carbon capture and sequestration, and nuclear generation could provide a number of benefits". Of particular interest is the graph of electric load and renewable generation because it shows that this low wind and solar problem may extend over multiple days.

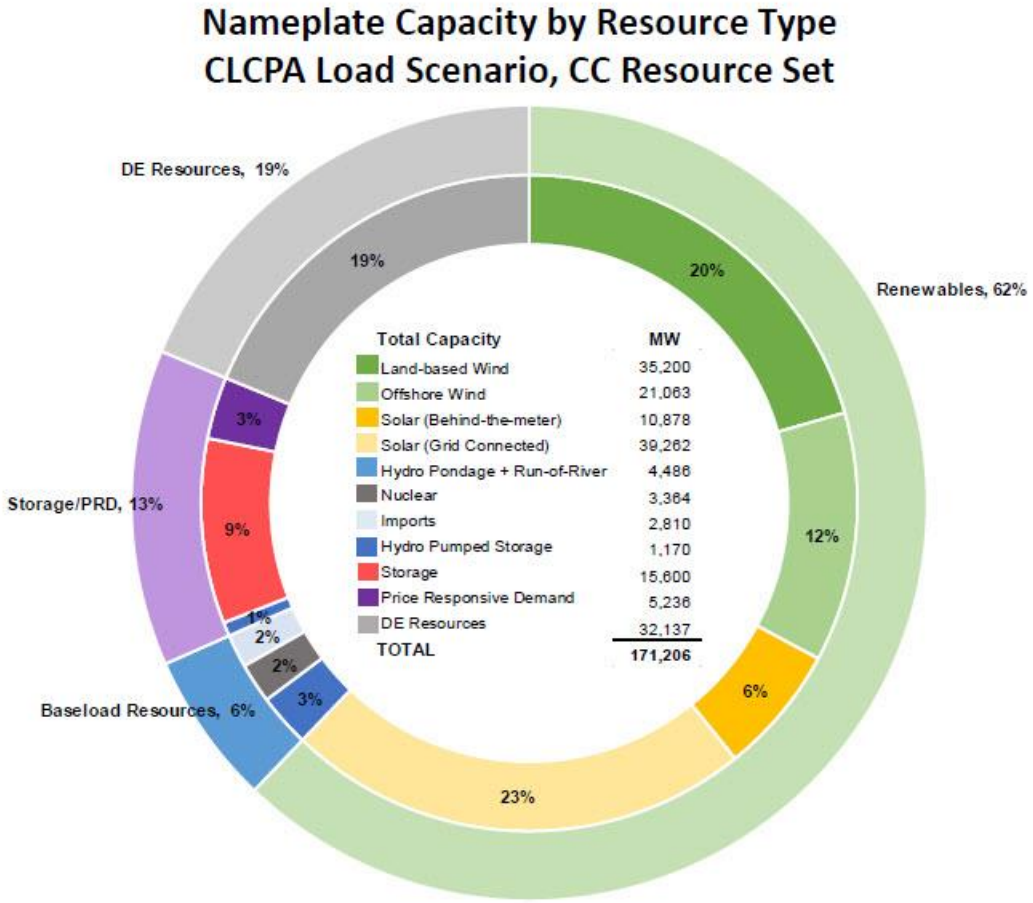


Analysis Group

On September 10, 2020 the Analysis Group presented a discussion of draft recent observations as part of the New York Independent System Operator (NYISO) Climate Change Phase II Study. That discussion included a slide titled "Attributes of Generic Resource Required for Grid Reliability". In their analysis they included a generic resource they called the Dispatchable & Emissions-Free Resource, or "DE Resource". The DE Resources are "included to maintain reliability during the highest load hours of each modeling period" and they "provide the majority of energy on the peak winter hour during the CLCPA load scenario". They state "The DE Resources are included to maintain reliability during the highest load

hours of each modeling period. DE Resources provide the majority of energy on the peak winter hour during the CLCPA load scenario."

Their projected nameplate capacity by resource type graphic is interesting. The DE resources category makes up 19% (32,137 MW) of the total capacity for their projected CLCPA load scenario. The Analysis Group includes the "DE Resource" in their model to achieve reliable solutions but also include the following caveats: "AG does not presume to know what resource or what fuel will fill this gap twenty years hence" and "the purpose of modeling it is to understand the attributes of the resource need".



Renewable Availability

I believe there is a meteorological aspect to renewables availability that has not yet been addressed adequately. As a party to the Department of Public Services (DPS) resource adequacy matters proceeding, docket Case 19-E-0530, I have submitted comments (described here and here) based on my background as a meteorologist who has lived in and studied the lake-effect weather region of Central New York. Both E3 and the Analysis Group have done studies of the weather conditions that affect solar and wind resource availability in New York but they did not address renewables availability adequately.

The Analysis Group (AG) estimated what electric generating resources will be necessary to meet the projected loads during extreme-weather or physical disruption events to simulate conditions that "increase demand and/or reduce or eliminate the availability of renewable resources and transmission

infrastructure." I am not satisfied that their work is sufficient to determine the magnitude of the worst renewable availability because the treated the effects of wind using 2009 data and sun using 2006 data separately and I believe it is necessary that both parameters be evaluated simultaneously. AG also relied on work by the National Renewable Energy Laboratory that used modeling results to estimate solar radiation from satellite derived hourly values. In order to properly replicate lake-effect cloud effects I believe that numerous surface observations are needed. I have no problem with the wind data used but their estimate of wind generation only looked at a low wind speed cutoff. Wind generation output can also be curtailed when the winds are too fast.

Because the lakes create meso-scale features, most notably lake-effect snow and clouds, that can affect solar resources many miles from the lake shore, I strongly recommend that meteorological data available from the NYS Mesonet meteorological system be used to determine the availability of wind and solar energy over as long a period as is available. The NYS Mesonet is a network of 126 weather observing sites across New York State so it can provide representative data for this kind of analysis. If historical meteorological data are used to estimate solar and wind output against the observed load, suitably adjusted for climate and climate policy, then it will be a much better test than using the assumptions made by the Analysis Group.

Conclusion

The overarching future energy reliability problem is that in order to maintain current reliability standards we need resources that can replace the loss of intermittent wind and solar energy that E3 shows can last for multiple days in the winter. When heating and transportation are electrified the electric system has to provide power or people could freeze to death in the dark. E3 and the Analysis Group both have a future resource category, E3 (firm capacity) and Analysis Group (DE Resources), that fulfills the need for dispatchable power without GHG emissions during those periods. Importantly, the Analysis Group DE resources category makes up 19% (32,137 MW) of their projected total capacity.

The task for those charged with implementing the power generating goals of the CLCPA is to propose resources that will meet this need. E3 gives some examples but the Analysis Group avoids being specific. The International Energy Agency (IEA) recently published "Special Report on Clean Energy Innovation" that classified the technology readiness level of technologies that could be dispatchable without GHG emissions. CLCPA recommendations for these technologies should consider the readiness of whatever technologies they propose.

Even though the general perception is that wind and solar is ready to go for the transition, the fact is that the problem of their intermittency must also be addressed. Every member of the Climate Action Council, advisory panels and working groups should understand that this problem exists and the ramifications of this issue on the energy strategies they propose.

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