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October 11, 2018

To: New Jersey Board of Public Utilities
44 S Clinton Ave
Trenton, NJ 08625

Re: Comments to the 2019 Energy Master Plan

General: In order for the state to meet their stated Green House Gas (GHG) reduction goals, there will have to be unprecedented innovation and cooperation amongst all of those participating. There are significant technical hurdles, massive changes in how we produce, distribute, and consume energy and resistance we are likely to face as a result, and costs associated with these changes, especially in the near-term. We see this as nothing short of a “moonshot” scale program not undertaken in this state before.

Here are our specific comments:

1. NJ must actively take steps to decrease the consumption of the fossil fuels that emit CO² at the point of combustion. These devices should be replaced with “electrified heating” to move the source of pollution back to the production facility where it can be dealt with. It makes no sense to continue incentivizing the replacement of existing fossil fuel space heating devices with a newer model through the NJ Clean Energy Program (NJCEP). Every new device installed today will be in the inventory for the next 15 to 20 years, and beyond the initial 2030 reduction goal.
2. We currently have only two available electrified heating choices in the US: 1. the cold climate Air Source Heat Pump (ccASHP), and 2. The Ground Source Heat Pump. The NJCEP has decided to promote the ccASHP (also known as “mini-splits”) as the preferred solution and has zeroed out incentives for GSHPs. We believe this will only serve to produce a high electric consumption peak during very cold winter pre-dawn hours when these devices cannot meet the building load demand without electric backup heat. Although manufacturers claim these units can maintain capacity with a Coefficient of Performance (COP) of 2 down to about 5⁰ F the drop-off in practice is much more substantial. This kind of device does not

compare favorably with GSHPs that can provide twice or more performance (and half the demand) under those conditions.

3. We believe there is a third electrified heat option that should become part of the solution set but is not yet available in the US market – the Air Source/Ground Source Hybrid. Such a system employs both an air exchanger and a ground exchanger. Such a design takes advantage of the air in more moderate conditions and changes to the ground to service the more extremes - hot summer days and cold winter ones. The ground can also be used as temporary thermal storage to be charged when favorable air conditions exist, or to collect heat or cold from a solar thermal collector. We see such systems as requiring a ground exchange loop as small as ¼ normally needed, substantially reducing drilling and extending our drilling assets. We also believe the overall project would cost 25% less than a GSHP. Such units are currently available for sale in Germany that are unfortunately not compatible with the US 60 Hz power system. Such a system could be built today using available water-to-water GSHPs and a “dry cooler” however it’s not clear they would qualify for existing rebates as written.
4. The GSHP option can meet the entire building load at any winter design day in NJ if the system is designed that way. The NJCEP has traditionally considered heat pumps as cooling devices and have required they be sized that way. In a heating dominant climate like ours this virtually ensures that auxiliary electric heat will be required, producing a similar spike in peak winter conditions as with the ccASHP. NJ must adopt the recent 2015 International Residential Code (or later) that permits sizing to 100% of the heating load when using variable speed equipment. In itself, variable speed heat pumps can attain yearly performance almost twice as good as even 2 speed equipment. For a relatively small investment in better equipment we can significantly tamp down the yearly load on the electric grid while substantially shaving the winter demand peak. Moderating demand will be critically important as we struggle to maintain our nuclear plants online into the foreseeable future, and begin phasing in wind generation and additional solar.
5. The best strategy to avoid major generation, transmission, and distribution investments would be to install electrified space heating that requires no more demand than the conventional air conditioning equipment it will replace. This can be done with GSHPs all the way down to winter design temperatures. The good news is that central air conditioning already has a very high market penetration in the state and the current grid can handle that load.
6. Another strategy to tamp down demand and reduce the requirement for new generation, transmission and distribution is to build better buildings to updated building codes. While moving to insulation and sealing requirements all the way to “Net Zero” would be ideal, substantially improving current minimum requirements is apt to require the least investment from society.
7. NJ needs to stop approving projects to build gas pipelines into new territory. These pipelines are generally considered an 80 year investment so it makes no sense to construct what could become a “stranded asset” in the 12 to 32 year time horizon.

8. NJ needs to mandate the use of electrified heating assets for new construction projects and major renovations unless a defensible waiver is approved to install a fossil fuel system instead. We must start getting in front of this problem.
9. Solar energy – both from photovoltaic (PV) panels and from thermal collectors - needs to be a large part of the new electric generation capability. We would emphasize the need to install a large portion of solar PV in “Community Solar Farms”. While rooftop solar has become popular with those who want to enjoy the benefits in their own home or business, the simple truth is that not all roofs face south, have the proper tilt (about 40° at our latitude) or have enough direct sunlight (too much shade). Dollar for investment dollar, a Community Solar Farm would provide far better benefits per investment dollar than rooftop.
10. Solar PV will not, however, resolve the new winter peak demand that we will see as heat pumps become widely deployed. Solar output will be lower during winter when we’ll be needing it most simply because we have fewer hours of possible sunlight, the winter skies are typically cloudier, and the sun sits lower in the sky causes it’s photons to hit more obliquely.
11. Power storage – large amounts of storage will be required to level the variability of both wind and solar generation. NJ currently has only one such facility in Yards Creek built over 50 years ago. It can store and release 420 MW over a 5.7 hour period at max. Oakridge Laboratory did a study of potential new sites in the US about 7 years ago – none were identified in NJ. Other potential technologies are based mostly around batteries. PSE&G recently proposed only 35MW in storage at a cost of \$180M in their recent “Clean Energy Future Plan”. This will not be nearly enough new capacity.
12. There have been proposals to use the battery in the new electric vehicles that will be put onto the road for grid storage. Considering there are almost 6 million cars, trucks, and buses in NJ this can potentially represent a large battery storage resource that can be used secondarily without a major new standalone investment. It will require vehicle chargers be “smart” and allow charging during off peak hours when kWhrs are less expensive to be sold back onto the grid when they are worth more. It will also require either Net Metering like we have with solar (although time based) or Smart Meters. This will bring the consumer into the solution, promote the purchase of electric vehicles, and provide an opportunity for them to offset their electric bill or perhaps make a profit.
13. An electrified space heating system must also have a high COP Domestic Hot Water (DHW) solution as well. The widely available options are an electric tank (COP=1) or a Hybrid Electric Heat Pump water heater with a yearly performance at about 2. However DHW use is peaky just like space heating, although it’s not tied just to winter pre-dawn hours. The 6:30 AM to 10 AM peak is the result of people rising, turning up their thermostats, and taking showers for work or school. A similar peak occurs in the evening from about 5:30 PM to 9 PM as people return from work or school, have dinner, take additional showers, and do laundry. We need a high COP

solution that can be provided by a GSHP system. While there is currently no standalone tank-type solution available on the US market, WaterFurnace is offering such a component solution for use in New York State using a water-to-water GSHP coupled to a special electric tank they sell. The New York State Energy Research and Development Authority (NYSERDA) have approved this approach and are rebating it at \$3,500. We believe a standalone tank, when an offering by a US manufacturer becomes available, this rebate could be cut in half.

- 14.** With a large number of electric vehicles coming online to compete against electrified space and DHW heating, we'll need time of day rates for charging for those vehicles to help level the demand. This may mean much of the charging would be during the day when solar PV output is at its highest and perhaps secondarily during non-daylight times when either DHW production or winter space heating does not come into play. This may require a Smart Meter to accomplish. It will also mean that many businesses may have to install chargers so employees can charge up during working hours instead of at home. Businesses could provide an almost no cost strategy of placing those chargers closest to the building essentially becoming "perk" parking spots for electric vehicle owners.
- 15.** NJ needs to work harder on financing options for Clean Energy projects. Although legislation was passed some time ago to implement Property Assessed Clean Energy (PACE) financing it has only been implemented in a few counties and only for commercial projects. This vehicle should become widely available and include residential financing.
- 16.** Electric rates in NJ continue to among the highest in the nation while natural gas is very low due to a current glut of product. While this may be good for some consumers it has the effect of pushing potential clean energy equipment buyers towards the very equipment we need to decrease. Even a high COP GSHP system is hard to justify on heating cost savings against the latest condensing gas furnaces and boilers. NJ should establish a new discounted electric rate for high COP heating customers to help promote low GHG choices. It will be very difficult to change customer's minds when both the initial installation and the fuel cost are higher in order to reduce GHG emissions. Such rates were prevalent decades ago when utilities actually promoted low COP electric resistance heating.
- 17.** Better cost comparisons can be made today against both propane and fuel oil systems versus high COP electric heating systems. NJ should start an immediate program to target these very customers for conversion to high COP electric heating. These are considered "low hanging fruit" and are the very customers being targeted by the NYSERDA program in neighboring New York State (NYS).
- 18.** NJ should be proactive in forming standards for the installation of new electrified heating asset projects to ensure they achieve maximum efficiency and comfort, and ensure private investors that the systems are indeed achieving the benefits claimed. NJ should take NYSERDA's lead in developing not only a program that rebates GSHPs but also develop a comprehensive set of guidelines for contractors to follow

in order to engage in those projects. This should include training and certification for the trades in the requisite areas to ensure high quality projects are being deployed.

- 19.** The NJCEP had added numerous, valuable and free training for the HVACR trades to raise their level of competence. Currently there is no offering for GSHPs. To be successful, we need the vast number of those working in the HVACR trade to understand GSHP so that technology will be offered to prospective customers. It is unreasonable to think a tradesman, who only installs fossil fuel devices, to offer a GSHP he/she knows nothing about. To the contrary, the customer may be told they just don't work, they are too expensive, or a myriad of other reasons not to purchase.
- 20.** We believe a vast number of the technological issues associated with reducing GHG emissions can be resolved with equipment already available today, or equipment that is already in the development pipeline. The one major exception could be CO² capture equipment that may need to be a part of the solution arsenal to achieve our goals. The biggest issue could become change management – getting the people of NJ, and the large number of businesses and industries that will be impacted by GHG reduction, behind this initiative. This will take a major outreach along many lines. Similar outreach programs are already underway in NYS – NJ should again try to benefit from their lead.

Thank you for letting us submit our comments. We'd be glad to expound on any of these comments in the future.