Memorandum

TO: CLAUS BECKER & PHIL THAYER, ON BEHALF OF BELMONT CLEAN ENERGY

FROM: THOMAS VITOLO, PHD, (617) 453-7036, TVITOLO@SYNAPSE-ENERGY.COM

DATE: JUNE 12, 2015

RE: REVIEW OF BELMONT CITIZENS' PROPOSED MAY 25 DISTRIBUTED GENERATION POLICY

At the request of Claus Becker and Phil Thayer of Belmont, Massachusetts, Synapse Energy Economics, Inc. (Synapse) reviewed the distributed generation compensation policy proposed on May 25, 2015 by Belmont citizens. It is our understanding that the Belmont Light Board is considering revising its rate structure for residential customers with solar PV generators and seeks a rate structure that does not negatively impact customers without solar. This memo describes our findings regarding the citizens' proposed policy's impacts on those ratepayers and answers the key question: *Is the newly proposed tariff fair to non-participants?*

Elements of good rate design

Good electric rate design has:

- Equity goals: just and reasonable rates, and subsidy-free;
- Efficiency goals: promote efficient use of resources and allow competitive entry;
- Social goals: universal service, conservation, economic stimulus, assisting vulnerable populations;
- Operational goals: allow the utility to collect legitimate costs, balance sheet stability, apportion costs fairly.[1]

These goals are often at odds with each other, requiring judgment as elected or appointed leaders seek to resolve those tensions with a clear, simple, and easy to implement tariff structure. Net metering is the simplest and easiest solar-friendly policy to administer, which is in part why state law in 44 states require investor owned utilities to employ a net metering tariff: it is by far the most prevalent tariff structure for distributed PV.[2] Nevertheless, policy makers seek out alternatives for a variety of reasons, and in doing so they must balance the needs of all ratepayers.

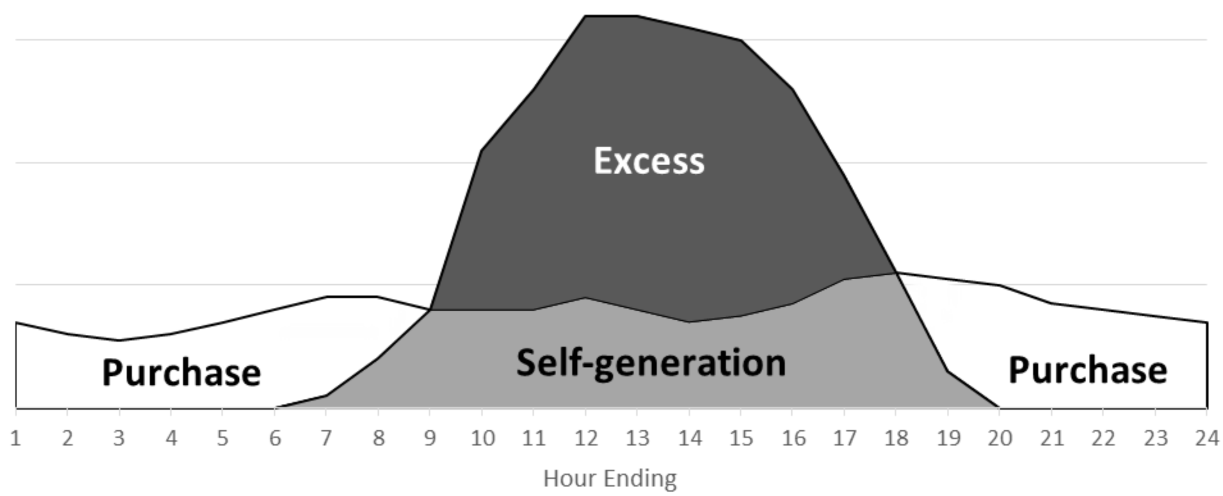
[1] Dr. James C. Bonbright, "Principles of Public Utility Rates," 1961.

[2] http://ncsolarcen-prod.s3.amazonaws.com/wp-content/uploads/2015/04/Net-Metering-Policies.pdf

Is the newly proposed tariff fair to non-participants?

To answer this question, it is important to consider the impacts on non-participants—ratepayers without solar—during three distinct periods during a participant's day: customer purchase, customer self-generation, and customer excess generation. Figure 1, below, depicts the interactions between customers with PV and Belmont Light over the course of a day.

Figure 1. Schematic of daily consumption and generation of Belmont customers with PV



During times of customer purchase, the participant and the non-participant each pay for what they're consuming; neither group is cross-subsidizing the other. During times of customer purchase, the new tariff is fair to non-participants.

During times of customer self-generation, the participant is meeting some or all of his or her own demand without the help of the utility (and, thus, without the help of the non-participant). A utility is not entitled to collect revenue on electricity sales that did not occur, and any impact on non-participants is identical to situations in which the participant reduced demand during those hours due to the installation of energy efficient appliances or a change in consumption habits. During times of self-generation, the tariff is fair to non-participants.

During times of customer excess solar generation, the participant is selling surplus electricity to the utility. If the price the utility pays the participant is equal to or less than the cost it would face buying from ISO-NE, then the utility is procuring electricity from PV at the same or better price. In cases where solar PV participants are imposing the same cost to the utility that ISO-NE would be imposing, non-participants are indifferent. When participants reduce utility costs, rates are pushed downward, benefiting non-participants. Either way, non-participants are being treated fairly.

To better understand the effect distributed PV has on non-participants, it can be helpful to consider each component of the electricity Belmont Light procures on behalf of its customers. Because municipal light plants like Belmont Light don't pay profits to shareholders, their rates serve as a very good approximation for the costs the utility actually incurs to provide service. The Belmont Light residential tariff has the following components: a fixed customer charge, and volumetric charges for distribution, transmission, generation, and conservation. By reviewing the impact distributed PV has on each of these categories, it can be determined if, in aggregate, non-participants are worse off, as well off, or better off because neighbors have installed PV.

Customer charge

The customer charge is a fixed fee, and represents the costs the utility faces regardless of electricity sales. Billing operations, the customer help desk, and maintaining the utility's public website are three examples of these costs. Because distributed PV participants must still pay the customer charge under the proposed PV tariff, utility revenue and cost associated with this portion of the residential tariff are unchanged, rendering no impact on non-participants.

Distribution charge

The tariff's volumetric distribution charge is used to fund local distribution services – the wires, poles, and other equipment within Belmont owned by the Belmont Light. Although nationally value of solar experts argue the exact cost-savings impact distributed PV customers have on the distribution grid, there is widespread agreement that the impact is both extremely small at low penetrations and rather costly to measure. For this reason, many studies and rate proposals assume a proxy cost of $0. That is, a common and reasonable assumption is that the distributed PV participant's impact on the utility's cost is zero. As the utility's proposed payment for avoided distribution costs is also zero, there is no distribution-related impact on non-participants.

Transmission charge

The tariff's volumetric transmission charge is used to pay ISO-NE for procured transmission services – Belmont's share of the wires, poles, and other equipment outside of Belmont necessary to get electricity to the town border. Typically, municipal utilities are charged a monthly fee based on the utility's total load at the time of the New England system's monthly peak (not the town's peak). The New England system frequently peaks at hour end 14 (the time between 1 pm and 2 pm), and often the hour before or the hour after. Although the charge is based on power demand, Belmont collects the revenues necessary to pay the cost through a volumetric charge (i.e. per kWh). Similarly, the PV proposal would pay the avoided costs due to PV through a per kWh payment. Therefore, by dividing the percent of a day's sales during the New England system peak hour by the percent of a day's total PV generation during the same hour, we can determine if Belmont Light is paying more or less than the value of the load reduction due to PV. If the ratio exceeds 1.0, Belmont Light would be overpaying for the transmission costs avoided. Conversely, if the ratio is less than 1.0, Belmont Light would be saving more dollars because of PV than it would be paying in transmission payments to the PV generators.

The fraction of PV output generated during the system peak hour is 10 to 20 percent of its daily output. Conversely, the fraction of Belmont's daily sales during the hour of system-wide peak load is lower, perhaps 5 to 10 percent. Determining the expected ratio over the course of a year requires data is not publicly available at this time, but it is probable that the ratio is well under 1.0, suggesting a net Belmont Light benefit. Therefore, because Belmont Light would be avoiding more dollars of system cost than it would be paying PV generators, the proposal is more-than-fair to non-participants with respect to transmission.

Generation charge

The residential tariff's generation charge is used to pay ISO-NE for two grid products: energy and capacity. When Belmont Light purchases energy from ISO-NE, it pays the locational wholesale price of energy *for that hour*. Because the ISO-NE wholesale prices of energy fluctuate as a function of the aggregate demand and supply across New England, prices are typically highest during early afternoon (approximately 2 pm) and lowest during the low demand overnight hours. Similarly, ISO-NE wholesale energy prices are typically higher during the summer, and lower during winter. In other words, solar PV's daily and seasonal profile allow Belmont Light to avoid buying energy during times of higher prices.

Belmont Light doesn't have residential rates that vary with the time – effectively, Belmont Light charges customers an average energy price to account for use during high ISO-NE energy prices and low ISO-NE energy prices. As a result, due to PV customers, Belmont Light will reduce it's purchasing of high priced energy from ISO-NE, but only compensate the PV customers an average price from energy. In this regard, non-participants are being treated more than fairly – they'll have lower future bills due to the PV on neighbors' roofs.

In addition to energy, the residential tariff's generation charge is used to pay ISO-NE for capacity. Similar to transmission, the capacity charge is typically assessed by ISO-NE monthly, and is based on the utility's load during the hour of system-wide peak usage. Therefore, as with transmission, the utility faces lower costs because the distributed PV reduces the utility's load during the hour that costs are assigned. The same ratio described above – with the ratio of Belmont Light's sales on the peak hour to total daily sales in the numerator, and the ratio of PV generation's peak hour generation to total daily generation on the denominator applies with capacity payments as well. As the ratio is identical to that in the transmission analysis, so too is the conclusion. Because Belmont Light would be avoiding more dollars of system cost than it would be paying PV generators the proposal is more-than-fair to non-participants with respect to capacity. With avoided costs of both energy and capacity exceeding the corresponding payments to PV generators, the cumulative effect is amplified: under the proposal, it is reasonable to expect that the generation charge payment for PV generation of energy and capacity is less than the benefits Belmont Light receives. Non-participants are treated more than fairly with respect to the generation charge.

Conservation charge

Finally, the residential tariff's conservation charge is presumably used to fund conservation, demand-side management, and energy efficiency expenditures,[3] although specific information is difficult to find

[3] Account number 906 of Electric Operation and Maintenance Expenses, as found in the 2014 Belmont Light Annual Report, http://www.belmontlight.com/upload-pdf/2014_Annual_Report.pdf

on the Belmont Light website. There are two benefits of expenditures from this account – reduced cost to Belmont Light ratepayers and the accompanying reduction in pollution and consumption of natural resources. Because natural gas is the fuel on the margin during nearly all generating hours in New England, every kWh of local PV-generated electricity displaces one kWh of gas-fired generation (more than 1.0 kWh when one considers transmission losses). Broad-scale energy efficiency programs typically pay multiple cents per kWh of avoided system generation – under this tariff, Belmont Light will pay $0.0024 per avoided kilowatt-hour, akin to over 90 percent less than typical energy efficiency programs. Applying the conservation charge to excess PV generation purchases far more conservation than typical efficiency programs, suggesting that non-participants are being treated more than fairly with respect to the conservation charge under the proposed PV tariff.

Conclusion

The scope of this review was limited to the question of whether or not the proposed policy would have negative economic impacts on Belmont residents without PV panels. With the information available, we can reasonably assume that non-participants will not face an unfair burden of costs as a result of the citizens' proposed policy. In the case of several of the types of charges in the rate structure, non-PV customers actually benefit from their neighbors having solar. Note this review did not explore whether or not this would be an optimal policy for ratepayers with PV panels as well as non-participants. Very likely, it is not. However, policy makers must balance many different considerations, including the need to act decisively using the best available information in order to provide policy certainty.

About Synapse Energy Economics, Inc.

Synapse Energy Economics is a research and consulting firm specializing in energy, economic, and environmental topics. Since its inception in 1996, Synapse has grown to become a leader in providing rigorous analysis of the electric power sector for public interest and governmental clients.

Synapse's staff of 30 includes experts in energy and environmental economics, resource planning, electricity dispatch and economic modeling, energy efficiency, renewable energy, transmission and distribution, rate design and cost allocation, risk management, cost-benefit analysis, environmental compliance, climate science, and both regulated and competitive electricity and natural gas markets. Several of our senior-level staff members have more than 30 years of experience in the economics, regulation, and deregulation of the electricity and natural gas sectors, and have held positions as regulators, economists, and utility commission and ISO staff.

Tommy Vitolo, PhD, Senior Associate

Tommy Vitolo is a senior associate at Synapse. He earned his PhD in systems engineering from Boston University, and has more than seven years of professional experience as a consultant, researcher, and analyst. Since joining Synapse in 2011, Dr. Vitolo has focused on utility resource planning, variable resource integration, avoided costs, and other issues that typically involve statistical analysis, computer simulation modeling, and stochastic processes. He has filed expert testimony in Missouri related to utility integrated resource planning, in South Carolina related to a methodology for calculating the costs and benefits of solar net energy metering, and in California regarding the state's Long Term Procurement Plan proceeding affecting the three largest investor-owned utilities. He has also reviewed and critiqued the numerical analysis, modeling, and decision strategies of integrated resource plans and certificates of public convenience and necessity submitted by utilities located in Kansas, Missouri, New Mexico, Georgia, Kentucky, Nebraska, Colorado, Illinois, and North Carolina. Before joining Synapse, Dr. Vitolo worked at the Massachusetts Institute of Technology's Lincoln Laboratory, where he designed algorithms and implemented software to create network topologies for orbital, aerial, land-based, and nautical vehicles. Dr. Vitolo serves as an elected town meeting member in Brookline, Massachusetts.