BEFORE THE
LONG ISLAND POWER AUTHORITY

IN THE MATTER of a Three-Year Rate Plan Case 15-00262

REBUTTAL TESTIMONY
OF
BRYAN IRRGANG
ON
SALES AND REVENUE FORECASTING

Date: June 4, 2015

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I. WITNESS QUALIFICATIONS AND DESCRIPTION OF TESTIMONY

Q. Please state your name and title.

A. My name is Bryan Irrgang. I am the Manager of Electric Load Forecasting for PSEG LI.

Q. Have you previously submitted pre-filed testimony in this proceeding?

A. Yes, as a member of the Sales and Revenue Forecast Panel.

Q. What is the purpose of your testimony here?

A. I will discuss my response to the prepared testimony of DPS Staff regarding the electric sales forecast for the rate plan period.

Q. Do you support any exhibits as part of your rebuttal testimony?

A. Yes. I support the following exhibits which were prepared by me or under my supervision:

Exhibit___(SRFP-REB-1) – Year-To-Date April & Annual Sales
Exhibit___(SRFP-REB-2) – System Sales Forecast
Exhibit___(SRFP-REB-3) – Sales Per Customer
Exhibit___(SRFP-REB-4) – Sales Forecast Check

Q. Do you have any preliminary comments?

A. I would like to begin by expressing my appreciation for Staff's efforts in reviewing the electric sales forecast provided with my direct pre-filed testimony and supporting exhibits. It appears we agree in a number of key areas. For example, Staff did not suggest that my method of developing sales forecasting models with an annual frequency was disadvantageous. Staff also did not suggest that my method of using electricity use per customer as the dependent variable in all of my sales forecasting

models was less desirable than using total sales. I also note that Staff's approach was similar to mine in its use of both an annual model frequency and electricity use per customer as the dependent variable, which appears to suggest Staff's agreement with the arguments I made supporting that approach.

II. STAFF'S RECOMMENDED SALES FORECAST

Q. Have you reviewed the sales forecast submitted by Staff, covering the years 2015 – 2018, as presented on page 1 of Exhibit_(AL-2) ?

A. Yes. After careful analysis my conclusion is that the sales forecast recommended by Staff is unsupportable and should not be accepted in place of my sales forecast.

Q. Please explain how you reached this conclusion.

A. Examination of Staff's recommended sales forecast revealed an immediate and obvious concern that its projection for 2015 appeared to be significantly higher than could be reasonably supported. That high forecast for 2015 is carried forward through the subsequent years, rendering its entire forecast for the years 2015 through 2018 unacceptable.

Q. What indication did you find that Staff's recommended system sales forecast for 2015 appeared high?

A. Using the 19,852,246 MWh of weather normalized sales reported for the system for 2014 (and as provided in response to DPS-PRELIMINARY-0069) as a reference point, in order to reach Staff's recommended system sales forecast of 20,361,737 MWh in 2015 would require 509,491 MWh (2.6%) of annual growth, an amount that has not been approached in ten years.

Q. Did you investigate further?

A. Yes, I found that Staff's recommended sales forecast for 2015, in comparison to weather normalized experienced sales for 2014, included slight decreases of 8,384 MWh (0.1%) in residential sales and 4,985 MWh (0.8%) in other sales (for street lighting, railroad, Brookhaven National Labs and electric vehicles) but an exceptionally large increase of 524,534 MWh (5.3%) in commercial and industrial sales. From the weather normalized value of 9,730,020 MWh of commercial and industrial sales reported for 2014 (and as provided in response to DPS-SRFP-0402), Staff's forecast of 10,254,554 MWh for 2015 would represent an unprecedented amount of annual growth, one that has never been approached. Therefore, in my review of Staff's forecast, I focused my attention on commercial and industrial sales.

Q. How did you confirm your concerns about Staff's commercial and industrial sales forecast for 2015?

A. By consideration of weather normalized sales experienced during the January through April period and the subsequent full year sales. The 2,970,213 MWh of weather normalized commercial and industrial sales experienced during January through April 2015 is 24,816 MWh (0.8%) below the 2,995,029 MWh of sales experienced last year, suggesting that sales are not maintaining the pace of last year. Furthermore, weather normalized commercial and industrial sales for January through April 2015 are below the amount for the same period in each and every one of the last eleven years; however, not once during those years did the subsequent annual sales reach the amount recommended by Staff for 2015, as shown in Exhibit___(SRFP-REB-1).

Q. Did you consider anything else to confirm your concerns?

A. Yes, I also considered that the weather normalized commercial and industrial sales for January through April 2015 are tracking 95,973 MWh below LIPA's approved budget forecast. This year-to-date sales variance indicates projected year-end sales of 9,836,799 MWh, which is 417,775 MWh (4.0%) below DPS Staff's forecast.

Q. How could the concerns you have raised about DPS Staff's sales forecast been avoided?

A. During an initial check to establish reasonableness, the growth represented by DPS Staff's sales forecast for 2015 over the weather normalized sales reported for 2014 should have been thoroughly analyzed. Such an analysis would have revealed that DPS Staff's forecasted growth in commercial and industrial sales for 2015 appeared questionably high by historical standards.

Q. Please explain how the concerns about DPS Staff's sales forecast might have been addressed.

Year-to-date sales should have been examined in comparison with historical sales during the past ten years. This would have revealed that weather normalized commercial and industrial sales were not keeping pace with the sales for the same period during those prior years. At this point, the review would have revealed considerable evidence that DPS Staff's recommended sales forecast for 2015 is unlikely to be reached and so a more supportable forecast incorporating the year-to-date sales results would have been developed.

Q. How would that be accomplished?

A. There are a couple of ways to accomplish this step. One method would be to combine the weather normalized sales for January through April 2015 with the sales for May through December 2014. Another method would be to adjust the sales forecast in LIPA's Approved 2015 Budget with the year-to-date April sales variance. The latter method is preferred because the approved budget represents the economic outlook for 2015 while the former method relies heavily upon the economic conditions that existed in 2014. In addition, LIPA's Approved 2015 budget forecast was independently examined by the NYISO and found to compare favorably to their own internally developed forecast and thus was accepted by the NYISO for incorporation in its 2015 Load and Capacity Data "Gold Book" report, which is the statewide resource and reliability planning reference.

Q. Was LIPA's approved 2015 budget sales forecast available to the DPS Staff?

A. The 2015 sales forecast is included in LIPA's approved 2015 budget document which is available from the LIPA web site. Also, the associated 2015 budget sales forecast was submitted by PSEG LI in this proceeding with the direct pre-filed testimony of the Sales and Revenue Forecasting Panel, Exhibit__(SRFP-REB-5). DPS Staff did not request any of the monthly 2015 budget variance reports.

Q. What are the projected year-end sales that resulted from the 2015 budget variance analysis?

A. To begin, the projected-year-end ("PYE") values should be developed for all of the major components of the sales forecast. LIPA's Approved 2015 Budget sales were adjusted as follows: residential sales were adjusted up by the year-to-date variance of

43,352 MWh (0.5%) to 9,602,654 MWh; commercial and industrial sales were adjusted down by the YTD variance of -95,973 (-1.0%) MWh, to 9,836,799 MWh; other sales (street lights, railroad, Brookhaven National Labs, electric vehicles) were adjusted up by the YTD variance of 9,272 MWh (1.6%) to 594,718 MWh. Utilizing the Approved 2015 Budget and the sales variance for January through April, the projection for system sales is 20,034,170 MWh, which is 327,567 MWh (1.6%) lower than DPS Staff's recommended sales forecast for 2015.

Q. How could the 2015 projected-year-end sales be used to avoid the concerns with DPS Staff's recommended sales forecast?

A. The procedure is referred to by the Company as calibration. First, the reductions proposed by DPS Staff would be added back to DPS Staff's recommended sales forecast and also to the new PYE forecast for 2015. Next, the PYE 2015 sales would replace DPS Staff's recommended sales forecast for 2015. Then the growth rate (before reductions for DSM and cogeneration) from DPS Staff's forecast for 2016 would be applied to this new starting point. Next in turn annual growth rates from DPS Staff's forecast for 2017 and 2018 would be applied in the same manner. Finally, the reductions would be subtracted from the sales to produce the calibrated sales forecast.

Q. Is calibration of the sales forecast necessary?

A. I believe so. Calibration of the sales forecast accomplishes two important functions: first, calibration aligns the initial sales forecast with calendar month sales. Since the electricity use models are developed using the billing sales history, the initial sales forecast is more representative of billing month sales rather than calendar month

sales. However, it is calendar month booked sales and revenues that are used for budgets and financial reporting. History has shown that the differences between billing month and calendar month sales can be considerable, even on an annual basis. Second, since the electricity use models are developed from annual data, calibration is a technique to incorporate the latest, though not full-year sales results into the process. The Company applied calibration to our own initial sales forecast before filing, as described in the direct pre-filed testimony of the Sales and Revenue Forecasting Panel on page 15 for residential sales and page 21 for commercial and industrial sales. The calibration process was further described in the Company's response to DPS-SRFP-0239.

Q. Did DPS Staff provide an explanation as to why they did not calibrate their initial sales forecast?

A. The question was addressed on page 31 in the prepared testimony of DPS witness Liu:

> Q. Is a recalibration procedure required for your model forecasts?
>
> A. No. Because my forecast models are developed using historical data through 2014 and the model forecast has already reflected the full year sales of 2014.
>
> Q. Without a calibration adjustment, is your annual sales forecast representative of annual calendar month sales for the forecasting period?
>
> A. Yes. Although my models are developed using historical annual data of billing month sales, the forecast should be representative of the annual calendar month sales.

The witness goes on to explain that the differentials "for February through December will be eliminated when summed to the annual total," "thereby leaving only a small

year-to-year differential that may exist in part of the calendar month of December," which "should be minimized with a normal weather assumption."

First, by neglecting to consider calibration, DPS Staff chose to ignore the sales experience for January through April of this year, which temporally represents one third of the year and therefore could have given a fairly reliable indication of whether or not its forecast was on track – as explained above; the evidence suggests that their forecast is not on track. Second, annual billing month and calendar month sales can differ significantly, beyond weather effects and it is unreasonable, in my view, to ignore the risk.

Q. If DPS Staff had calibrated their initial sales forecast to incorporate the results for January through April of this year as you described above, what would DPS Staff's forecast have shown?

A. DPS Staff's calibrated sales forecast would be significantly lower than PSEG LI's sales forecast filed in this proceeding, in each of the years from 2016 through 2018, which follow from the decrease in the 2015 sales forecast. The results are shown in Exhibit___(SRFP-REB-2) which compares DPS Staff's recommended sales forecast, DPS Staff's forecast after calibration by PSEG LI and PSEG LI's filed sales forecast.

Q. Exhibit_(AL-4), pages 3 and 5 showing DPS Staff's Residential and Commercial Sales Forecast Models, are dated April 2, 2015 - presumably by the software used to generate those models. At that time, obviously, sales for the complete month of April were unknown. Would an analysis using January through March sales suggest an outcome different from the conclusion reached when the sales results for April were also considered?

A. No, the conclusion would have been the same. The weather normalized year-to-date commercial and industrial sales through March also tracked well-below both the prior year and below the approved 2015 budget forecast. Since temporally the three-month

period represents one quarter of the year, this is still a significant indication of the need for calibration. DPS Staff's recommended sales forecast, if calibrated to the 2015 projected year-end sales developed using the weather normalized sales results for January through March only, would not be significantly different from the one described earlier which was calibrated to the PYE sales developed to include the April sales results.

Q. Would an analysis using the ten-year average definition of cooling- and heating-degree-days recommended by Staff instead of the thirty-year average used by PSEG LI have led to a different conclusion?

A. No, the conclusion would have been the same because first, the difference in annual sales when weather-normalized by replacing degree day averages for a thirty-year period with averages for a ten-year period is small, less than 0.2% and second, all sales results previously weather-normalized would move in the same (lower) direction so the difference would remain more or less unchanged.

III. DPS STAFF'S MODELS

Q. Please describe DPS Staff's sales forecast modeling.

A. DPS Staff developed two sales forecasting models, one for residential sales and the other for commercial and industrial sales. Using a single model for the residential sales forecast is appropriate because the residential customers are fairly homogeneous with 85 to 90 percent of electricity use consumed by customers in the General Use rate class. There is, however, significant diversity among the commercial and industrial customers. One indication of the diversity is by rate class: About 47 percent of customers are in the Small General Use rate class but consume about 5

percent of the electricity; about 48 percent of customers are in the Large General Use class and consume about 35 percent of the electricity; and about 5 percent of customers are in the Large, Multiple Rate Period class and consume about 60 percent of the electricity. Another measure of the diversity in electricity use within the commercial and industrial sector is by NAICS sectors. For example, thirty years ago about 18 percent of electricity was consumed in the manufacturing sector, while now it is down to about 8 percent. As another example, electricity use per customer has increased by about 7 percent since the late 1980s for the entire commercial and industrial sector, but it has increased by 37 percent in the trade, transportation and utilities sector while declining by about 20 percent in the manufacturing sector. The point here is that a lot of information is lost when the entire commercial and industrial sector is represented by a single model which is why my preference is to model by NAICS sectors. For these reasons, in my view, using a single model to forecast commercial and industrial electricity sales is a simplified and unsupportable approach.

Q. Briefly describe the advantages of forecasting commercial and industrial electricity use by using eight NAICS sector models over the single model approach used by DPS Staff.

A. When the U.S. Department of Labor releases the Jobs Report each month (which usually occurs on the first Friday of the month) media attention properly focuses on which sectors are experiencing growth. For example, it examines whether there is more growth in the relatively low wage retail sector or in the better quality, more highly paid financial services sector, because some jobs are better for the economy

than others. The major economic series of employment and gross Long Island product are provided by our consultant by NAICS categories and therefore they align well with my models. In summary, since customers have different energy use intensities depending on which sector they are in, utilizing NAICS models that accept NAICS input assumptions is a more comprehensive way to develop the commercial and industrial electricity sales forecast in comparison to DPS Staff's single model approach.

Q. Please respond to DPS witness Liu's testimony that PSEG LI's forecast should not be adopted because "generally, most of the forecast models are specified incorrectly or failed important econometric tests"?

A. In the context of forecasting energy use for Long Island, the most important test is forecast accuracy. I have been using the same general configuration of one residential and eight NAICS sector regression models for 15 years and can report a mean absolute percent error (MAPE) of 1.1%. In my direct pre-filed testimony for the Sales and Revenue Forecasting panel on pages 23-24 I described how my forecast accuracy compares favorably to that of the EIA and the NYISO during overlapping periods.

Q. Please address the concern raised about positive serial correlation in your models?

A. The Durbin Watson test shows that the possibility of the presence of positive serial correlation cannot be rejected for three of my eight NAICS models (at the 5% significance level) indicating the undesirable possibility that adjacent residuals may be tending to cluster by sign (auto-correlated). One method to address autocorrelation is to utilize an adjustment model which predicts the current value of

the dependent variable using adjustments to the previous (or lagged) values of both the dependent and explanatory variables. Such a model estimates a coefficient of adjustment to establish how much of the lagged variables are used to make predictions. If the coefficient of adjustment had a value of zero then there would be no impact from either the lagged dependent or explanatory variables and only the current values of the explanatory variables would be used to predict the dependent variable. A coefficient of adjustment with a value of unity represents the other extreme, and the predicted value of the dependent variable would include the full value of the lagged dependent variable. Staff proposes a residential sales forecasting model with a coefficient of adjustment close to unity at 0.95530 (shown as the AR(1) autoregressive term on page 3 of Exhibit_(AL-4)), which for the intended application leaves relatively little of the prediction to be explained by the explanatory variables. My opinion is that this is not a satisfactory approach to forecasting annual electricity use on Long Island, and for this particular application auto-regression should be reserved for confirmation of the results obtained from more fully specified models, as I'll explain further on.

Q. How do you address the concern raised about multicollinearity in your models?

A. It is well known that much economic data exhibits some degree of linear dependence, known as multicollinearity. One solution would be to remove from the regression model those explanatory variables which exhibit a near-linear dependence. If the relationship between explanatory variables is not perfectly linear, than some information may be lost when variables are dropped. Alternatively, one can usually

obtain good forecasts despite the presence of multicollinearity, although it may be difficult to disentangle the influences of the explanatory variables. In my view, in this particular application of forecasting electricity use for Long Island, including more explanatory variables is justified.

Q. How do you ensure that your modeling preferences are not leading to misleading sales predictions?

A. Although it is my preference not to employ auto-regression to address serial correlation and not to exclude explanatory variables which are significant but may exhibit some linear dependencies, I typically perform a robustness check to confirm the acceptability of the sales forecast under development. The robustness check consists of identifying those models that exhibit the possibility of positive serial correlation in the residuals and/or multicollinearity in the explanatory variables from among the nine regression models that are under consideration for developing the sales forecast. The identified models are then re-specified utilizing a single economic variable to address concerns about multicollinearity and/or by introducing a coefficient of adjustment auto-regressive term to address concerns about positive serial correlation. Results for the robustness check results are shown in Exhibit___(SRFP-REB-3). Note that these re-specified models exhibit low possibilities of the presence of either serial correlation or multicollinearity but generally have less explanatory capability than the preferred models already presented in Exhibit__(SRFP-1). Results from these re-specified models provide a check of the robustness of my recommended sales forecast. For this illustration, I re-

specified six out of the nine sales forecasting models while three of the preferred models were retained. Among the six re-specified models, five contain an auto-regressive term and economic variables were dropped from three models. The resulting predicted annual growth rates for sales represents what I consider to be acceptable differences, relative to the MAPE described above, when compared to the filed forecast. See Exhibit___(SRFP-REB-4).

Q. Please summarize your position on the models.

A. Developing sales forecasting models involves a series of preferences. DPS Staff has chosen a simplified approach to modeling electricity use on Long Island. DPS Staff has developed two models, each utilizing a single econometric variable, income (per capita) in the residential model and real gross metro product in the commercial and industrial model, with all other economic impacts on electric sales occurring by proxy. So for example, in 2009 growth in real gross metro product declined by 0.6%, about the same as the decline for the prior year of 0.7%; however, employment declined by 2.9%, much more steeply than the decline of 0.1% in the prior year, and commercial and industrial sales declined by 4.8%, again much more steeply than the decline of 1.1% for the prior year. In this case, the change in sales and employment were similar to each other and dissimilar from real gross metro product. The situation is further exacerbated by DPS Staff's use of a single model for the entire commercial and industrial sector, meaning much information about the dissimilar NAICS sectors does not contribute to the commercial and industrial sales forecast. In comparison to DPS Staff's two simple models, my nine models present a more complete

representation of electricity use on Long Island, incorporating more economic information of significance, including income, home prices and interest rates, employment, and real gross metro product by NAICS sector. Finally, the sales forecasts resulting from my models are checked for robustness against simpler models. For these reasons my sales forecasting models should be accepted over DPS Staff's models.

Q. Have you reviewed DPS Staff's recommended customer forecast?

A. Based on the results through April, while DPS Staff's residential customer forecast appears reasonable, its commercial and industrial customer forecast is not and it is the Company's commercial and industrial customer forecast that is more likely to occur.

Q. Do you have an opinion on DPS Staff's residential and commercial and industrial customer forecasting models?

A. The difference is that the DPS Staff's customer forecast models use auto-regressive adjustments to the customer level from the previous year with some contribution made by the expected growth in the dependent variable, households for residential customers or employment for commercial and industrial customers. The Company uses a committee to consider customer growth from prior years, expected growth in households, population and employment and also information from the Construction and Marketing departments.

Q. Did you review DPS Staff's comments regarding the Company's EER forecast?

A. Yes. DPS Staff, in their remarks concerning appliance standards and building codes, correctly states that the Company's projections for 2014 – 2015 were developed from a straw proposal for setting goals to reduce energy usage by 15 percent statewide by

2015. However, they neglected to state that the Company is using only one third of the proposed reductions, as demonstrated in our response to DPS-SRFP-0329. Although it is reasonable to assume that the curtailment of electricity use due to building codes and appliance standards as reflected in the sales history is captured by the sales forecasting models and propagated forward in predictions, it is not prudent to assume that all future effects are captured, since these reductions are taking place gradually over time, as noted by DPS Witness Liu on page 35 of his testimony in this proceeding. Therefore the approach of the Company to make continuing, although deeply discounted reductions for building codes and appliance standards in electricity use forecasts is sensible. Furthermore, in contradiction to DPS Witness Liu's statement on page 36 of his testimony in this proceeding, the Company's approach of reducing electricity use forecasts for building standards and appliance codes is not unique in the region. The NYISO, for example, explains in Section I (on pages 9 – 10) of its 2015 Load and Capacity Data "Gold Book" report:

> The NYISO employs a two-stage process in developing load forecasts for each of the 11 zones within the NYCA (New York Control Area). In the first stage, zonal load forecasts are based upon regression models that are reflective of annual changes in economic conditions and weather. In the second stage, the NYISO prepares forecasts of energy reductions resulting from statewide energy efficiency programs, new building codes and appliance efficiency standards, and the impact of retail solar PV. These forecasts are based upon new and updated information about the performance of such programs provided by the New York State Department of Public Service (DPS), the New York State Energy Research and Development Authority (NYSERDA), state power authorities, electric utilities, and through NYISO's

previous participation in the DPS Evaluation Advisory Group.

Q. Please discuss DPS Staff's proposed ten percent adjustment to the Company's DSM savings projections.

A. The DPS devised a ten percent reduction to DSM which is described as being specific for their sales forecasting models. I agree with the implication that the DSM savings as adjusted by DPS Staff are not appropriate for my sales forecast.

Q. Please summarize your recommendation for DSM.

A. The assumptions underlying the Company's development of reductions for building codes and appliance standards are reasonable and furthermore reducing forecasted electricity use by those expected reductions is consistent with the approach used by the NYISO for all of the Zones in New York State. Also, the DSM adjustments developed by DPS Staff are not applicable to the Company's sales forecast. For these reasons the reductions for building codes and appliance standards and the remaining components of EER as proposed by the company should be retained.

Q. Did you review DPS Staff's remarks concerning normal weather conditions for electric sales forecasting?

A. Yes. On the issue of normal weather I defer to the National Weather Service which continues to define normal weather as the average for a 30-year period. On the issue of normal weather for forecasting electricity use my method is consistent with the Energy Information Administration which used 30-year average weather for their 2014 Annual Energy Outlook report. I also found it inconsistent that DPS Witness Liu, on page 28 of his testimony in this proceeding, recommended using ten-year average weather for sales forecasting but using 30-year average weather for peak load

forecasting. For these reasons the Company's use of 30-year average weather should be accepted.

Q. Does this conclude your rebuttal testimony?

A. Yes, it does.