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Commissioner	:	C. Rechtschaffen
ALJ	:	S. Roscow
Witness	:	T. Renaghan

OFFICE OF RATEPAYER ADVOCATES
CALIFORNIA PUBLIC UTILITIES COMMISSION

Report on the Results of Operations for Pacific Gas and Electric Company Test Year 2019 Gas Transmission and Storage Rate Case

Chapter 16C
Throughput Forecast

San Francisco, California
June 29, 2018

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THROUGHPUT FORECAST

I. INTRODUCTION

This chapter discusses the Office of Ratepayer Advocates (ORA's) and Pacific Gas and Electric Company's (PG&E's) recommended throughput forecasts for the Gas Transmission & Storage (GT&S) forecast period 2019 through 2022.

Section II summarizes ORA's and PG&E's recommended throughput forecasts for the core and non-core sectors for the GT&S test period. The core sector consists of residential, small commercial, large commercial, interdepartmental and core Natural Gas Vehicles. The noncore sector includes industrial distribution, industrial transmission, noncore NGV, and market and non-market Electric Generation (EG) classes of service. Section III analyzes the economic and assumptions underlying ORA's and PG&E's recommended throughput forecasts. Section IV includes a detailed discussion of the econometric model results obtained by ORA and PG&E. Section V discusses

II. SUMMARY OF RECOMMENDATIONS

- For the residential class of service ORA recommends throughputs of 507 (Mdth/D) in 2019, 500 (Mdth/D) in 2020, 496 in 2021 and 493 (Mdh/D) in 2022. PG&E recommends average temperature year throughputs of 524 (Mdth/D), 516 (Mdth/D), 513 (Mdth/D), and 509 (Mdth/D) for 2019, 2020, 2021, and 2022, respectively. On a cold year heating degree basis ORA recommends residential throughput of 572 (Mdth/D) in 2019, 564 (Mdth/D) in 2020, 560 (Mdth/D) in 2021, and 557 (Mdth/D) in 2022. PG&E recommends cold year throughput of 592 (Mdth/D) in 2019, 584 (Mdth/D) in 2020, 581 (mdth/D) in 2021 and 577 (Mdth/D) in 2022.
- For the small commercial class of service ORA recommends average temperature throughputs of 216 (Mdth/D) in 2019 and 2020, 215 (Mdth/D)

in 2021, and 216 (Mdth/D) in 2022. PG&E, on the other hand, forecasts small commercial throughput of 211 (Mdth/D) in 2019, and 210 (Mdth/D) for each of the years 2020 through 2022. On a cold year basis ORA recommends throughputs of 232 (Mdth/D) for 2019 and 2020, 231 (Mdth/D) for 2021, and 232 (Mdth/D) in 2022. PG&E forecasts cold year small commercial throughput of 227 (Mdth/D) for 2019 and 226 (Mdth/D) for each of the years 2020 through 2022.

- For the large commercial sector ORA recommends throughputs of 19 (Mdth/D) for each of the forecast years 2019 through 2022. PG&E recommends large commercial throughput of 19 (Mdth/D) for 2019 and 18 (Mdth/D) for 2020, 2021, and 2022. On a cold year basis ORA recommends large commercial throughput of 20 (Mdth/D) for 2019 and 19 (Mdth/D) for 2020, 2021, and 2022. For a cold year PG&E recommends large commercial throughputs of 19 (Mdth/D) for the 2019 – 2022 forecast period.

- For the core interdepartmental class of service ORA and PG&E recommend throughputs of 0.4 (Mdth/D) for the 2019 – 2022 forecast period. On a cold year basis ORA and PG&E recommend throughputs of 0.5 (Mdth/D) for 2019 and 2020. For 2021 and 2022 ORA recommends throughputs of 0.4 (Mdth/D), and PG&E recommends throughputs of of 0.5 (Mdth/D) in 2019 and 2020 and 0.4 (Mdth/D) for 2021 and 2022.

- For the core Natural Gas Vehicle (NGV) ORA and PG&E recommend throughput of 8 (Mdth/D) for 2019, 9 (Mdth/D) for 2020 and 2021, and 10 (Mdth/D) in 2022. NGV gas demands are not weather sensitive so there is no difference between average and cold temperature years for this class of service.

- On an average temperature basis ORA recommends total core throughput of 751 (Mdth/D) for 2019, 745 (Mdth/D) for 2020, 740 (Mdth/D) in 2021, and 738 (Mdth/D) in 2022. PG&E recommends slightly higher throughputs of 762 (Mdth/D) in 2019, 755 (Mdth/D) in 2020, 751 (Mdth/D) in 2021, and 747 (Mdth/D) in 2022. On a cold year basis ORA recommends total core throughput of 832 (Mdth/D) in 2019, 825 (Mdth/D) in 2020, 821 (Mdth/D) in 2021 and 819 (Mdth/D) in 2022. PG&E recommends total cold year core throughput of 846 (Mdth/D) in 2019, 839 (Mdth/D) in 2020, and 836 (Mdth/D) in 2021, and 832 (Mdth/D) in 2022.

- For the industrial distribution class of service ORA recommends average year throughput of 71 (Mdth/D) for the 2019 – 2022 forecast period. PG&E recommends industrial distribution throughput of 68 (Mdth/D) for each of the forecast years 2019 through 2022. On a cold year basis ORA recommends throughputs of 73 (Mdth/D) for each year of the forecast period. For 2019 PG&E recommends industrial distribution throughput of 71 (Mdth/D) and 70 (Mdth/D) for 2020, 2021, and 2022.

- PG&E aggregates industrial transmission, non-core Natural Gas Vehicles (NGV) and backbone classes. For this aggregate class ORA recommends 496 (Mdth/D) in 2019, 491 (Mdth/D) in 2020, 497 (Mdth/D) in 2021, and 505 (Mdth/D) in 2022. PG&E recommends throughput of 501 (Mdth/D) in 2019, 503 (Mdth/D) in 2020, 512 (Mdth/D) in 2021, and 524 (Mdth/D) in 2022.

- For the non-market electric generation class of service ORA and PG&E forecast gas throughput of 175 (Mdth/D) for the 2019 – 2022 forecast period

- For the market responsive electric generation class of service ORA and PG&E forecast throughput of 231 (Mdth/D) in 2019, 224 (Mdth/D) in

2020, 220 (Mdth/D) in 2021, and 223 (Mdth/D) in 2022. PG&E forecasts total non-core gas demand of 976 (Mdth/D) in 2019, 970 (Mdth/D) in 2020, 975 (Mdth/D) in 2021, and 990 (Mdth/D) in 2022.

Table 16C-1 compares ORA's and PG&E's throughput forecasts under average temperature conditions. Table 16C-2 compares ORA and PG&E's throughput forecasts under cold year conditions.

Table 16C-1

ORA and PG&E Throughput Forecasts
Average Year

Category/Year	2019	2020	2021	2022
Residential				
ORA	507	500	496	493
PG&E	524	516	513	509
PG&E>ORA (%)	3.35 %	3.20 %	3.42 %	3.25 %
Small Commercial				
ORA	216	216	215	216
PG&E	211	210	210	210
PG&E>ORA (%)	-2.31 %	-2.77 %	-2.32 %	-2.78 %
Large Commercial				
ORA	19	19	19	19
PG&E	19	18	18	18
PG&E>ORA (%)	0.00 %	-5.26 %	-5.26 %	-5.26 %
Interdepartmental				
ORA	0.4	0.4	0.4	0.4
PG&E	0.4	0.4	0.4	0.4
PG&E>ORA	0.00 %	0.00 %	0.00 %	0.00 %
Core NGV				
ORA	8	9	9	10
PG&E	8	9	9	10
PG&E>ORA	0.00 %	0.00 %	0.00 %	0.00 %

Table 16C-1
(Continued)

Category/Year	2019	2020	2021	2022
Total Core				
ORA	751	745	740	738
PG&E	762	755	751	747
PG&E>ORA (%)	1.60 %	1.34 %	1.49 %	1.22 %
Non Core				
Industrial Distribution				
ORA	71	71	71	71
PG&E	68	68	68	68
PG&E>ORA (%)	-4.22 %	-4.22 %	-4.22 %	-4.22 %
Industrial Transmission, Backbone & NGV				
ORA	496	491	497	505
PG&E	501	503	512	524
PG&E>ORA	1.00 %	2.44 %	3.02 %	3.76 %
Non Market EG				
ORA	175	175	175	175
PG&E	175	175	175	175
PG&E>ORA (%)	0.00 %	0.00 %	0.00 %	0.00 %
Market EG				
ORA	231	224	220	223
PG&E	231	224	220	223

PG&E>ORA (%)	0.00 %	0.00 %	0.00 %	0.00 %
Total Non Core				
ORA	973	961	963	974
PG&E	976	970	975	990
PG&E>ORA (%)	1.00 %	1.01 %	1.25 %	1.64 %
Wholesale				
ORA	10	10	10	9
PG&E	10	10	10	9
PG&E>ORA (%)	0.00 %	0.00 %	0.00 %	0.00 %
Total Volumes				
ORA	1,735	1,716	1,713	1,721
PG&E	1,748	1,735	1,736	1,747
PG&E>ORA	0.70 %	1.11 %	1.34 %	1.51 %

Table 16C-2

ORA and PG&E Throughput Forecasts
Cold Year

Category/Year	2019	2020	2021	2022
Residential				
ORA	572	564	560	557
PG&E	592	584	581	577
PG&E>ORA (%)	3.50 %	3.55 %	3.75 %	3.59 %
Small Commercial				
ORA	232	232	231	232
PG&E	227	226	226	226
PG&E>ORA (%)	-2.16 %	-2.59 %	-2.16	-2.59 %
Large Commercial				
ORA	20	19	19	19
PG&E	19	19	19	19
PG&E>ORA (%)	-5.00 %	0.00 %	0.00 %	0.00 %
Interdepartmental				
ORA	0.5	0.5	0.4	0.4
PG&E	0.5	0.5	0.4	0.4
PG&E>ORA	0.00 %	0.00 %	0.00 %	0.00 %
Core NGV				
ORA	8	8	9	10
PG&E	8	9	9	10
PG&E>ORA	0.00 %	0.00 %	0.00 %	0.00 %

Table 16C-2

(Continued)

Category/Year	2019	2020	2021	2022
Total Core				
ORA	832	825	821	819
PG&E	846	839	836	832
PG&E>ORA	1.68 %	1.70 %	1.83 %	1.59 %
Non Core				
Industrial Distribution				
ORA	73	73	73	73
PG&E	71	70	70	70
PG&E>ORA %	-2.74 %	-4.11 %	-4.11 %	-4.11 %
Industrial Transmission,Backbone & NonCore NGV				
ORA	496	491	497	505
PG&E	501	503	512	524
PG&E>ORA %	1.00 %	2.44 %	3.02 %	3.76 %
Non-Market EG				
ORA	175	175	175	175
PG&E	175	175	175	175
PG&E>ORA	0.00 %	0.00 %	0.00 %	0.00 %

Table 16C-2

(Continued)

Category/Year	2019	2020	2021	2022
Market Responsive EG				
ORA	231	224	220	223
PG&E	231	224	220	223
PG&E>ORA	0.00 %	0.00 %	0.00 %	0.00 %
Total Non Core				
ORA	976	964	966	976
PG&E	978	973	977	992
PG&E>ORA %	0.20 %	0.94 %	1.14 %	1.64 %
Wholesale				
ORA	11	11	11	11
PG&E	11	11	11	11
PG&E>ORA %	0.00 %	0.00 %	0.00 %	0.00 %
Total Volumes				
ORA	1,819	1,800	1,797	1,806
PG&E	1,835	1,822	1,824	1,835
PG&E>ORA	0.88 %	1.22 %	1.50 %	1.61 %

III. Economic and Demographic Assumptions

Since the economic and demographic assumptions play a large role in the econometric forecasts recommended by ORA and PG&E it is useful to explore those assumptions before turning to a discussion of the specific econometric results obtained by ORA and PG&E.

Based on data taken from Moody's Analytics, PG&E projects improving economic conditions in its service area. PG&E explains that Moody's August 2017 forecast projects that: "service and technology employment gains [will] continue in PG&E's service territory and will continue to lead in net job gains throughout the rate case period. Moody's Analytics projects economic growth in the service area to be above average when compared with the rest of the United States (U.S)"[1]

The March 2018 UCLA Anderson Forecast for California and the Nation also concludes that economic growth in California will exceed that in the U.S. For example, between 2017 and 2018 UCLA projects that real personal income growth in California will grow by 3.10 % compared to 2.5 % for the U.S. Similarly, between 2019 and 2020 UCLA projects real personal income growth for California of 2.8 % compared to 2.5 % for the entire U.S. economy.[2] While UCLA's forecast is for continued economic growth in Northern California they note that there has been a recent slowdown in job growth in Northern California. UCLA concludes that "The important trend reversal can be seen in Silicon Valley, San Francisco and the North Bay. Earlier in the expansions they were growing much more rapidly than the U.S. and more rapidly than other parts of California…In spite of this slowdown, California continued to lead the Nation in job growth with the slack in net new jobs in the Bay Area in 2017 being taken up by the Inland Empire, San Joaquin Valley, and Sacramento, and the Delta."[3] ORA notes that PG&E's gas service area includes

[1] A.17-11-009, November 17, 22017, p. 16C-4.

[2] UCLA Anderson Forecast for the Nation and California, March 2018, p. California-77.

[3] UCLA Anderson Forecast for the Nation and California, March 2018, p. California-7.

Sacramento and parts of the San Joaquin Valley. ORA concludes that PG&E's 2019 GT&S economic and demographic forecast assumptions are reasonable.

IV. Econometric Methodology and Results

ORA and PG&E developed econometric models to forecast throughput to the residential, small commercial, large commercial, industrial distribution, and backbone classes of service. The econometric models are used to develop a statistical relationship between historic gas throughput and explanatory variables such as weather, real average gas rates, and economic conditions in PG&E's service area along with seasonal factors. The coefficients generated by the econometric models are then coupled with forecasts of the explanatory variables to produce the econometric forecasts.

A. Residential Econometric Model

PG&E models residential use per customer as a function of heating degree days, real average residential gas rates, the post 1978 housing stock, a dummy variable capturing drought conditions in 2014, and a series of monthly dummy variables.[4] The model is estimated with monthly observations over the period from January 2006 through July 2017.

To forecast residential throughput ORA regressed the natural log of historic residential use per customer on heating degree days, the natural log of real average gas rates, the natural log of the post 1978 housing stock, a dummy variable capturing 2014 drought conditions, and a series of monthly dummy variables. ORA models the price term as a 12 month polynomial distributed lag.[5] ORA estimated its model over the period December 2000 through July 2017.

[4] A dummy variable is a variable that takes on the value one at a particular point in time and zero elsewhere.

[5] A polynomial distributed lag forces the coefficients to lay upon a pre-specified polynomial of a certain degree. In this the degree of the polynomial is one so that the price term is simply a linear 12 month lag.

B. Small Commercial Econometric Model

PG&E forecasts small commercial throughput by regressing historic small commercial use per customer on real average gas rates and an employment variable reflecting the "economic shift in employment from manufacturing to services"[6] heating degree days, and a series of monthly seasonal dummy variables. The model was estimated with monthly observations from over the period January 2004 through July 2017. PG&E's small commercial model yields a negative coefficient on the employment variable. PG&E explains that this counter intuitive result "captures the higher adoption of natural gas energy efficiency within certain job sectors (such as financial, information, and professional/business services) through the shift of the workforce in PG&E's service territory to these sectors."[7]

ORA's small commercial model is based on a log-log functional form[8] with historic small commercial usage regressed on the log of real average gas rates lagged six months, the log of total service employment in PG&E's service area, heating degree days, and monthly seasonal dummy variables. ORA's model was estimated with monthly observations over the period February 2014 through July 2017. ORA's model yields the standard negative statistically significant coefficient on real average gas rates, and, in contrast to PG&E, a positive statistically significant coefficient on employment.

C. Large Commercial Econometric Model

To forecast sales to the large commercial (GNR2) sector PG&E regresses historic large commercial throughput on heating degree days, real average gas rates, employment and monthly seasonal dummy variables. PG&E's model is estimated

[6] A.17-11-009, November 17, 2009, WP16C-1.

[7] PG&E response to ORA Data Request, ORA-042-QO2, March 22, 2018.

[8] A log-log functional form is a model in which the dependent and independent variables are measured in natural logs.

with monthly observations over the period January 2006 through July 2017. As in the case of the small commercial sector, PG&E's employment variable is constructed "to reflect the economic shift in employment from manufacturing to services.[9] PG&E's large commercial model yields a negative sign on employment which PG&E attributes to increased energy conservation on the part of the large commercial sector.

To forecast sales to the large commercial sector ORA regressed historic large commercial usage on heating degree days, real average gas rates lagged six month months along with seasonal dummy variables. ORA adopted a log-log functional form and estimated its model over the period February 2009 through July 2017.[10]

D. Industrial Distribution Level (GNTD)

PG&E forecasts industrial transmission level gas demand by regressing historic gas demand on heating degree days, real average gas rates lagged 12 months, a measure of service employment in its service area, and a series of monthly seasonal dummy variables. As in the case of the small and large commercial models PG&E distribution level gas demand model yields a negative coefficient on employment. PG&E's model is estimated with monthly observations over the period January 2014 through July 2017.

For this class of service ORA adopts a log-log functional form. ORA regresses historic gas consumption on heating degree days, the log of real average gas rates lagged six months, and the log of total service employment in PG&E's service area, along with monthly seasonal dummy variables. ORA estimated its model with monthly observations over the period February 2007 through July 2017. In contrast to PG&E, ORA's model yields a positive coefficient on employment.

[9] A.17-11-009, November 17, 2017, p. WP 16C-1.

[10] ORA attempted many alternative specifications with various measures of employment. In each case the models yielded negative coefficients on the employment variable. As a result ORA dropped the employment variable from its large commercial model.

E. Industrial Distribution Level (GNTT)

PG&E forecasts industrial transmission level gas demand by regressing historic throughput on real average gas rates lagged 12 months, a variable capturing industrial activity in its service area along with monthly seasonal dummy variables. PG&E estimates its model with monthly observations over the period January 2003 through July 2017. In contrast to PG&E's small and large commercial models, the variable capturing economic activity in the PG&E service area has a positive and statistically significant coefficient.

ORA's industrial gas model is similar to PG&E's. ORA forecasted industrial level gas throughput by regressing historic industrial gas demand on real average gas rates, industrial economic activity in the service area, along with a series of monthly seasonal dummy variables. In contrast to PG&E, ORA employed a log-log functional form and estimated its model over the period February 2004 through July 2017.

F. Backbone Level Industrial Model

PG&E forecasts industrial backbone throughput by regressing historic backbone transmission throughput as a function of real industrial backbone gas rates lagged twelve months, industrial backbone customers, and a series of monthly seasonal dummy variables. The model is estimated with monthly observations over the period January 2005 through July 2017.

ORA considers PG&E's industrial backbone model reasonable and adopts PG&E's industrial backbone throughput forecast.

V. Non-Econometric Methodology and Results

This section discusses ORA's and PG&E's recommended gas demand for Utility Electric generation and gas throughput forecasts to PG&E's resale or wholesale customers. PG&E divides the Electric Generation (EG) sector into

customers that are sensitive changes in the demand for electricity and natural gas and those that are not.

A. Non-Market Responsive Electric Generation

PG&E explains that this sector "primarily consists of gas fired cogenerators whose output is generally not sensitive to prices in the electricity and gas markets because they generate electricity along some other energy product, usually steam."[11] For the forecast period PG&E forecasts 175 (Mdth/D) for the forecast period 2019 through 2022. This is "based on the most recent available 12 months of actual deliveries (August 2016 through 2017)."[12]

B. Market Responsive Electric Generation

PG&E relies upon the Market Builder Model to forecast gas throughput to the market responsive electric generation sector. PG&E explains that the: "Market Builder is an economic-equilibrium program that has been applied to various markets with spatially distributed supplies and demands such as the North American natural gas market."[13] The primary input assumptions driving PG&E market responsive EG gas demand are forecasted electricity demand, hydro conditions, natural gas prices and power plant additions.

For forecasted electric demand within California PG&E relied upon the California Energy Commission (CEC) 2016 Integrated Energy Policy Report. For areas outside of California "PG&E applied load growth rates from the December 2016 forecast by IHS Energy…"[14]

[11] A.17-11-009, November 17, 2017, p. 16C-9.

[12] A.17-11-009, November 17, 2017, p. 16C-9.

[13] A.17-11-009, November 17, 2017, p. 16C-11.

[14] A.17-11-009, November 17, 2017, p. 16C-13.

Market responsive gas demand is also impacted by the construction of new gas-fired power plants. The California utilities' increased reliance upon renewable energy products results in a decline in the construction of new gas-fired power plants and a reduction in the demand for natural gas. In its current GT&S forecast PG&E is assuming that: "renewable energy generation is projected to reach 35 percent of California load by the end of the rate case."[15]

Hydro conditions also impact market responsive natural gas demand. Hydro conditions are incorporated into the model by assuming that hydro generation will be "based on average generation between water years 2000 and 2015."[16]

Finally, this sector's gas demand is also influenced by forecasted natural gas prices. Gas price forecasts from the various sources of supply are based on data taken from May 2017 forecast taken from IHS energy.

ORA has reviewed PG&E's forecast assumptions for the market responsive electric generation gas demand and considers them reasonable. As a result, ORA adopts PG&E's market responsive electric generation gas demand forecast.

C. Wholesale Demand

PG&E's forecasts of gas throughput to its various resale customers are taken directly from these customers. ORA considers this approach reasonable and adopts PG&E's wholesales gas demand forecast.

D. Off System Revenues

ORA has reviewed PG&E's off-system revenue testimony and workpapers and concludes that PG&E's approach is reasonable. ORA adopts PG&E's forecasts of off-system revenues.

[15] A.17-11-009, November 17, 2017, p. 16C-13.

[16] A.17-11-009, November 17, 2017, p. 16C-13.

VI. Conclusion

This testimony has presented ORA's and PG&E's recommended throughputs for the 2019 – 2022 GT&S forecast period. For the core class of service ORA recommends slightly higher throughput volumes than does PG&E. For the non-class of service ORA also recommends slightly higher throughput volumes than does PG&E. ORA recommends the Commission adopt its throughput estimates for the 2019 – 2022 forecast period.

WITNESS QUALIFICATIONS

My name is Thomas Renaghan. My business address is 505 Van Ness Avenue, San Francisco, California, 94102. I am employed as a Public Utilities Regulatory Analyst V in the Office of Ratepayer Advocates' Energy Cost of Service and Natural Gas Branch. I am responsible for ORA's testimony regarding the recommended Throughput Forecasts.

I have a Bachelor of Arts Degree in Economics from California State University, Hayward and a Ph.D. in Economics from the University of California, Davis.

I have been employed with the Commission since January 1984. My experience with the Commission has been in the areas of labor and non-labor escalation, energy demand forecasting, and in the measurement of total factor productivity for electric, gas, and telecommunications firms.