BEFORE THE TENNESSEE PUBLIC UTILITY COMMISSION
NASHVILLE, TENNESSEE

February 15, 2018

IN RE:	**)**	
	)	
CHATTANOOGA GAS COMPANY	**)**	
PETITION FOR APPROVAL OF AN	**)**	
ADJUSTMENT IN RATES AND	**)**	**Docket No.**
TARIFF; THE TERMINATION OF	**)**	**18-** 00017
THE AUA MECHANISM AND THE	**)**	
RELATED TARIFF CHANGES AND	**)**	
REVENUE DEFICIENCY	**)**	
RECOVERY; AND AN ANNUAL	**)**	
RATE REVIEW MECHANISM	**)**	

DIRECT TESTIMONY OF

HEATH J. BROOKS

ON BEHALF OF

CHATTANOOGA GAS COMPANY

I. WITNESS INTRODUCTION

Q. Please state your name, position, and business address.

A. Heath J. Brooks, Rate Analyst I, Rate Design and Tariff Administration for Southern Company Gas ("SCG"), 10 Peachtree Place NE, Atlanta, Georgia 30309.

Q. Have you provided an outline of your educational background and professional experiences?

A. Yes. Exhibit HJB-8 to my testimony contains a summary of my educational background and professional experience.

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to support and describe the specific methods used to develop the normalized level of billing determinants and base revenue for the test period ending June 30, 2017 and for the attrition period ending June 30, 2019 for Chattanooga Gas Company ("CGC" or "the Company").

Q. Are you including any exhibits in connection with your testimony?

A. Yes, the following exhibits have been included:

- Exhibit HJB-1 - Test Period Actual Revenue to Attrition Period Forecasted Revenue
- Exhibit HJB-2 - Chattanooga Gas Company Residential Historical and Projected New Meters
- Exhibit HJB-3 - Chattanooga Gas Company Commercial Historical and Projected New Meters

- Exhibit HJB-4 - Graph of Chattanooga Gas Company Normalized Residential Use Per Customer Over Time
- Exhibit HJB-5 - Graph of Chattanooga Gas Company Normalized Commercial Use Per Customer Over Time
- Exhibit HJB-6 - 1987 to 2017 Normal Heating Degree Days
- Exhibit HJB-7 - Residential Cubic Spline Non-linear Pattern

Q. Were these exhibits and related schedules prepared by you or under your direct supervision?

A. Yes.

Q. Please identify the Minimum Filing Guideline ("MFG") Schedules that you will be sponsoring.

A. I am sponsoring MFG Schedules 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, and 41.

Q. How is your testimony organized?

A. My testimony is organized in the following manner:

- Section 1 - Attrition Period Base Revenues
- Section 2 - Forecasting Methods for Customers, Consumption, and Base Revenue
- Section 3 - Forecast of Other Revenues and Gas Cost Revenues

II. ATTRITION PERIOD BASE REVENUES

Q. Please summarize the results of CGC's attrition period forecast.

A. CGC's actual jurisdictional base rate revenue for the test period was $30.7 Million. When normalized for the most recent 30-year normal weather pattern, normalized jurisdictional test period base rate revenue is $31.99 million. The

forecasted normalized attrition period base rate revenue is $32.44 million. Exhibit HJB-1 provides a series of adjustments taking actual test period revenues to normalized attrition period revenues. Below is a simplified version of revenue adjustments.

Adjustment Title	Total Revenue
Test Year Total	**$ 68,115,720**
Removal of Unbilled	$ (243,571)
Removal of AUA	$ (230,770)
Removal of Non-Jurisdictional	$ (1,898,125)
Normalization Adjustment	$ 3,157,012
Test Year Normalized and Annualized	**$ 68,900,266**
Growth Adjustment	$ 2,336,002
Attrition Year Normalized and Annualized	**$ 71,236,268**

Q. What are the new customer growth and attrition rates for the attrition period?

A. The forecasted attrition period residential new customer growth is expected to be 1.58% at 901 customers from July 2018 to June 2019. Offsetting growth during the attrition period is annual residential customer attrition of -0.3% with a projected loss of 172 customers. Residential growth and attrition result in a net growth of 1.27%.

Commercial new customer growth is expected to be 1.33% at 111 customers. The Company assumes commercial attrition only occurs in the C-1 small commercial class due to the C-2 rate class not having historical attrition. C-1 attrition is expected to be 1.09% with a loss of 72 customers during the attrition period. Commercial growth and attrition results in a net growth of 0.46%. CGC does not expect major changes in customer count within the large industrial classes including T-3, I-1, F-1/T-2, F-1/T-2+T-1, T-1, and special contracts.

Q. How has consumption changed for CGC since its 2009 rate case?

A. Normalized residential average usage per customer ("UPC") continues to decline due to equipment efficiencies, while normalized commercial UPC continues to increase. Residential UPC has declined 4.6% from 2010 to 2017 and is expected to decline an additional 0.78% from the test year to the attrition period. Exhibit HJB-4 displays the declining usage trend in residential consumption. While residential UPC is decreasing, throughput volumes are expected to increase by 1.9% from the test year to the attrition period due to customer growth. Commercial UPC has increased 5.6% from 2010 to 2017 and is expected to increase an additional 0.15% from the test year to attrition period. The increase in commercial consumption appears to be a result of economic recovery from the 2008/2009 recession. Exhibit HJB-5 displays commercial UPC increasing over time. Commercial throughput volumes are expected to increase 1.2% from the test year to the attrition period. CGC's total throughput volume is expected to increase by 0.01% from the test year to the attrition period. The growth in residential and commercial throughput volume is being offset by a large special contract customer using less gas in the attrition period.

III. FORECASTING METHODS FOR CUSTOMERS, CONSUMPTION, AND BASE REVENUE

Q. Please discuss CGC's method for forecasting demand and base rate revenues for the attrition period.

A. Customers, usage, and base revenues are forecast using a multi-step process. Each customer class is first categorized into one of two groups – homogeneous

and non-homogenous – based primarily on consumption behavior. Homogenous customer classes are those that are large in terms of number of customers, but whose consumption, on an individual basis react similarly to causal variables, such as weather and gas prices. CGC's homogenous classes include residential and commercial customers under R-1, C-1, and C-2. The non-homogenous customer classes are small in terms of customer count and do not react similarly to causal variables. CGC's non homogenous classes include large industrial customers under T-3, I-1, F-1/T-2, F-1/T-2+T-1, T-1, and special contracts.

Q. Please continue.

A. The next part of the process includes four steps. First, forecasted usage per customer is developed for each customer class. Consumption equations are developed to determine the average UPC for the customers in the homogenous classes. Forecasted UPC for customers in the non-homogenous classes is developed by analyzing each customer's historical consumption and applying adjustments based on the customer's foreseeable demand requirements. Second, the estimated number of customers billed for each class is determined. Third, a consumption forecast for each class is calculated by applying the normalized UPC, referred to in step one, to the estimated number of customers billed in each class. The final step includes applying volumes, customer counts, and demand components to the existing rate structure resulting in a base revenue forecast.

Q. Is this the traditional manner in which CGC has developed its forecast?

A. Yes. The basic forecasting methods described here were employed by CGC in its 2006 and 2009 base rate proceedings. These methods are reviewed monthly

through activities such as variance analyses. This is an evolutionary process with the goal of continually improving forecast performance in which the methods are adjusted to increase accuracy. New techniques and causal factors are evaluated and are incorporated into the forecast models when they demonstrate improved forecast accuracy.

Q. How were the consumption equations referred to in step one developed for the Company's various customer classes?

A. For the Residential and Commercial classes, the Company employed statistical regression methods to correlate historical consumption with actual heating degree days and a time trend factor to develop models of gas usage per customer. A cubic spline term was also used in the development of the UPC models for residential and commercial customers to capture non-linear consumption patterns that will be discussed later in my testimony.

Q. Please describe the relationship between each of the factors referred to above – heating degree days and time trend.

A. These influential factors impact customer usage in various ways. A regression analysis allows the company to quantify the historical relationship between consumption and these factors, which results in a more accurate forecast of usage. The most notable influential factor impacting usage is weather (number of heating degree days). Trend variables recognize long term usage patterns. The most notable trend variable used in the revenue forecast captures the long term decline in residential consumption that's a direct result of more efficient equipment.

Q. How does weather impact customer usage?

A. Heating degree days measure how cold the weather is when usage occurs. Usage has a direct relationship with the number of heating degree days. As the number of heating degree days increases, natural gas used by customers also increases. Exhibit HJB-6 provides the normal heating degree days from 1987-2017.

Q. What is a time trend factor?

A. The time trend factor simply takes into account long-term trends that impact UPC. Declining residential UPC and increasing commercial UPC are both quantified using trend variables in the revenue model.

Q. How does the time trend factor quantify residential long term usage patterns?

Over time, residential consumers replace less efficient equipment with new, more efficient models resulting in lower gas usage. Homeowners may also add insulation and weather stripping to make their home more efficient. Newer homes added to the system have more efficient natural gas equipment installed, lowering the average residential UPC on CGC's system. The trend factor helps The Company recognize the declining UPC pattern that will likely continue to occur in the forecasted period. The decline in normalized residential consumption is illustrated in Exhibit HJB-4.

Q. How does the time trend factor quantify Commercial long term usage patterns?

Commercial UPC has steadily increased since the 2008/2009 recession. The time trend factor accounts for the steadily rising commercial UPC and projects it forward into the forecasted years of the rate case revenue model.

Q. What is a cubic spline term?

A. As temperatures exceed 55°F and are below 72°F, demand does not follow a simple linear pattern. The cubic spline allows the Company to more accurately forecast for spring and fall usage ("shoulder months") when there is considerable variability between warm and cold weather and when consumption is no longer a linear function. Consumption generally levels out to base load usage once temperatures surpass 72°F. The regression models used for forecasting UPC for the residential R-1 and commercial classes take into account the cubic spline term. Exhibit HJB-7 illustrates the non-linear residential consumption pattern that the cubic spline variable helps the company more accurately forecast.

Q. Were the discussed factors used to develop consumption equations?

A. Yes. The model for the Residential class employs 166 months of historical consumption and temperature data over the period February 2004 through November 2017, while the master Commercial equation also employs 166 months of historical consumption and temperature data over the period February 2004 through November 2017. The individual regression models for C-1 and C-2 employ 118 months of similar historical data over the period February 2008 through November 2017. From these models, the consumption equations that are used to develop monthly average UPC for the Residential and Commercial classes were derived. Review of the output statistics, use of holdout periods (i.e., segmenting the dataset into two periods and using one subset to develop a model and the other to evaluate equation performance), and validation through "back casting" (i.e., comparing actual historical results to the fitted values generated by

the statistical model) demonstrated the accuracy of the regression models selected. Please see MFG Schedule 29 for the consumption equations that were developed and graphs of the validations of the models through back casting.

Q. For the attrition period, how was the number of customers in each class developed?

A. The number of customers by class for the attrition period was developed as follows:

- The actual number of customers by class that were billed as of December 2017 was determined and used as the base starting point upon which new customer growth was added.
- A monthly forecast of new customers by class was developed from historical trends as well as coordination with the Company Marketing and Sales Departments. Further explanation regarding the development of the growth forecast is located in MFG Schedule 35-1. As explained in MFG Schedule 35-1, there is a strong correlation between new single family home starts and CGC new residential meter installations. Exhibit HJB-2 graphically displays the correlation between regional single family new home starts and new residential meters. The annual number of historic and forecasted new commercial meters is presented on Exhibit HJB-3.
- A seasonal pattern of changes in the number of active and inactive customers was developed from historical customer count data.
- A percentage of attrition (i.e., loss of customers due to switching to use of an alternative source of energy, business failures, etc.) was developed

from historical trends as well as coordination with the Marketing and Sales Departments.

- The total number of customers by class by month was developed by adding the monthly growth projections, seasonal changes in customer patterns, and monthly attrition projections to the September 2017 starting point.

Q. How was consumption developed for the customer classes?

A. Consumption by class for the Residential and Commercial class of customers was developed by multiplying the projected number of customers billed in the class for each month by the UPC for the month. The average monthly usage per customer was developed by applying the UPC derived from the consumption equation for the month with an input of expected natural gas prices and updated 30-year normal heating degree days for that month and multiplying by the number of average meter read days in the month.

Q. What heating degree day pattern was applied to the consumption equations?

A. To develop a normalized consumption forecast for the classes where consumption equations are employed, it was necessary to develop a normal heating degree day pattern for each day of the year. Heating degree days are the difference between a base 65^{o}F temperature and the average temperature for a day when that daily average is below the base temperature. The base 65^{o}F heating degree day pattern that was employed is presented in Exhibit HJB-6. It is based on 30 years of daily Hi-Lo weather data (July 1, 1987 through June 30, 2017) as measured by the National Oceanic and Atmospheric Administration ("NOAA") for Chattanooga's

Lovell Field. The new 30 year normal in the rate case revenue forecast has 142 less degree days than the current 30 year normal developed in the last rate case.

Q. How was consumption developed for the remaining classes?

A. For classes that were forecast by individual customer (Multi-Family R-4, T-3, F1/T2, F1/T2 + T1, I1, T1, and Special Contracts), the monthly consumption for the class represents the aggregate of the individual customer forecasts. The forecast by individual customer was prepared by reviewing historical monthly consumption data and adjusting for future known changes in demand resulting from customer expansions and contractions and customer loss.

Q. How were base revenues for the attrition year period developed?

A. The base revenues of $32.44 million shown in Exhibit HJB-1 were developed by applying the forecasted, normalized consumption and number of customers billed by class for the attrition period to a model of the existing rate structure of the Company's tariff.

Q. Were changes made to the structure of the forecast models that were used in the 2009 rate case?

A. Several changes were made to the influential variables used to forecast consumption for the Residential and Commercial rate classes and can be found in MFG Schedule 29. As stated above, new techniques are evaluated continually in an attempt to improve forecast accuracy. In order to improve the regression model used to forecast residential consumption, the following changes have been made:

- Knot (Base 55°F MRD at 65°F) has been changed to Knot (Base 55°F MRD at 72°F). As mentioned earlier, consumption does not follow a simple linear pattern. The new cubic spline variable used more accurately captures the non-linear consumption pattern that is seen between 55ºF and 72ºF.
- SDD (Base 55°F MRD, Lagged 1 Month) has been added to improve forecasted heat sensitive consumption.
- A fitting variable has been removed that was used to adjust for a prior period adjustment in March of 2007.

In order to improve the regression model used to forecast total commercial consumption, the following changes have been made:

- SDD72MRD has been removed, and SDD55MRD has been added to more accurately forecast heating sensitivity.
- SDD (Base 72°F MRD, lagged 1 month) has been removed, and SDD (Base 55°F MRD, lagged 1 month) has been added to contribute to heating sensitivity accuracy.
- TSDD72MRD has been added to reflect a trend regarding how commercial customers are using more gas when colder temperatures are present than they did in the past. This could be a result of commercial customers continuing to recover from the 2008/2009 recession.
- A fitting variable ("Feb17") has been added to adjust for a prior period adjustment taking place February 2017.

Q. Please continue.

Next, an updated 30-year normal heating degree day distribution was used to derive attrition period base revenues. The most recent 30-year period available (1987 - 2017) more accurately reflects usage and revenues that are subject to the recent changes in weather.

Q. Were new weather normalization factors developed as part of the filing?

Yes, Weather Normalization Adjustment ("WNA") factors were updated using the new weather pattern and usage forecast. By updating WNA factors, customers' bills will reflect the level of charges experienced at normal weather.

Q. Is the forecast model being filed as part of this proceeding?

A. Yes. The entire forecast model is being filed as part of MFG Schedule 25.

IV. FORECAST OF OTHER REVENUES AND GAS COST REVENUES

Q. Please list the sources of other revenue.

A. Other Revenue items include revenue from turn-ons, meter sets, returned checks, reconnects, late payment fees, and damage billing.

Q. Please explain procedures used to forecast revenue associated with these charges.

A. Miscellaneous revenues are forecast by looking at historical trends and adjusting for known future changes. The two most notable changes from test year to attrition year is a decline in damage billing revenues and miscellaneous revenues. Damage billing declines 19% as a result of CGC having abnormally high damage billing revenues in the test period. Miscellaneous revenue declines 37% as a result of Pivotal Home Solutions paying more royalty than is required during the test year. The Company budgets for the minimum royalty of $10,000. Further

explanation regarding the changes in miscellaneous revenue can be found in MFG 39.

Q. How were expected natural gas prices developed?

A. The wholesale futures price of natural gas during the attrition period, as reported by NYMEX on January 3, 2018, was used as the basis to project CGC's purchased gas adjustment ("PGA"). Regression equations were developed using historical NYMEX prices and historically set CGC retail prices. The calculations used to forecast CGC's PGA can be found in schedule 29 of the Minimum Filing Guidelines.

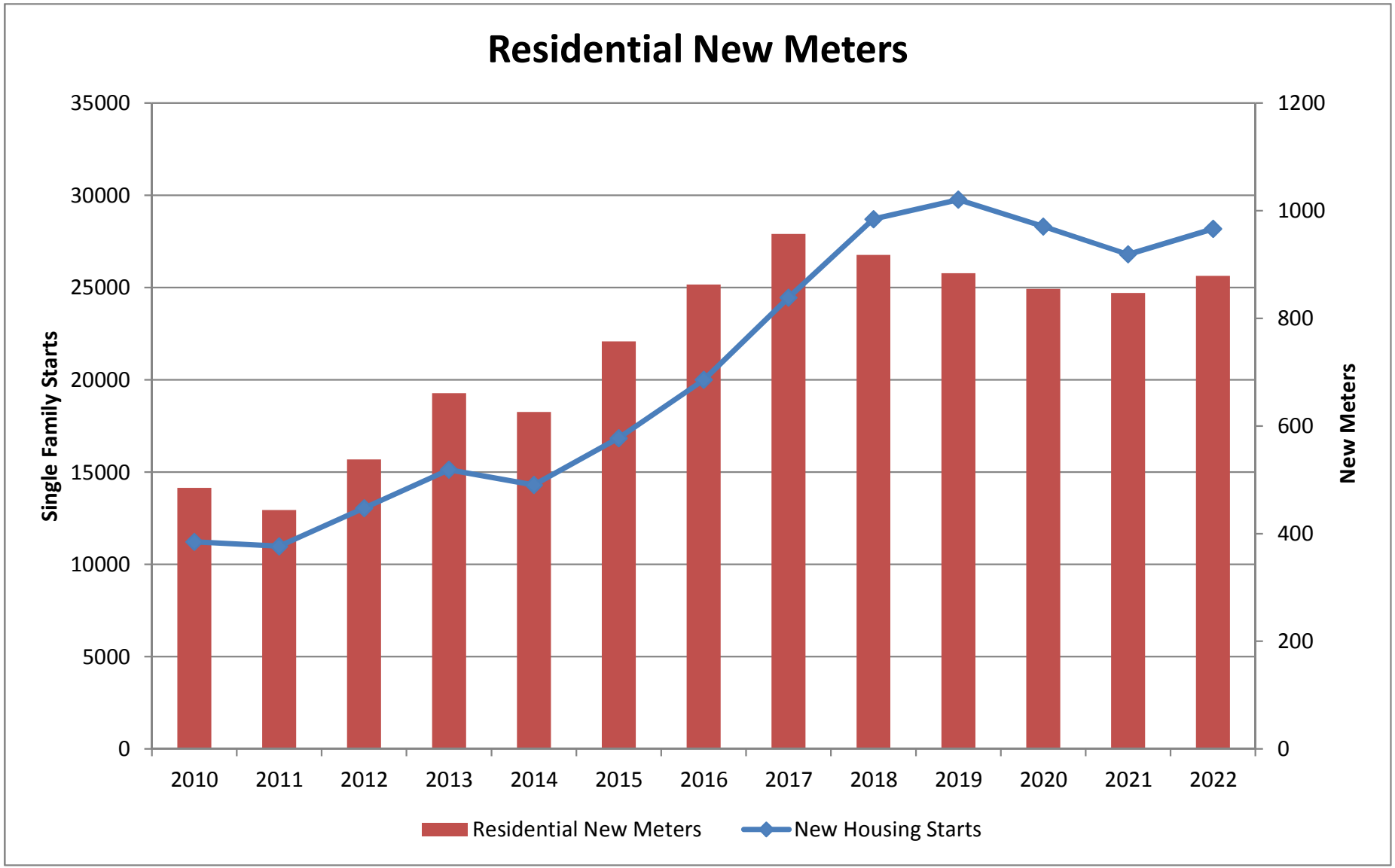
Q. What were the results of the attrition period base revenue and revenue forecast under current rates?

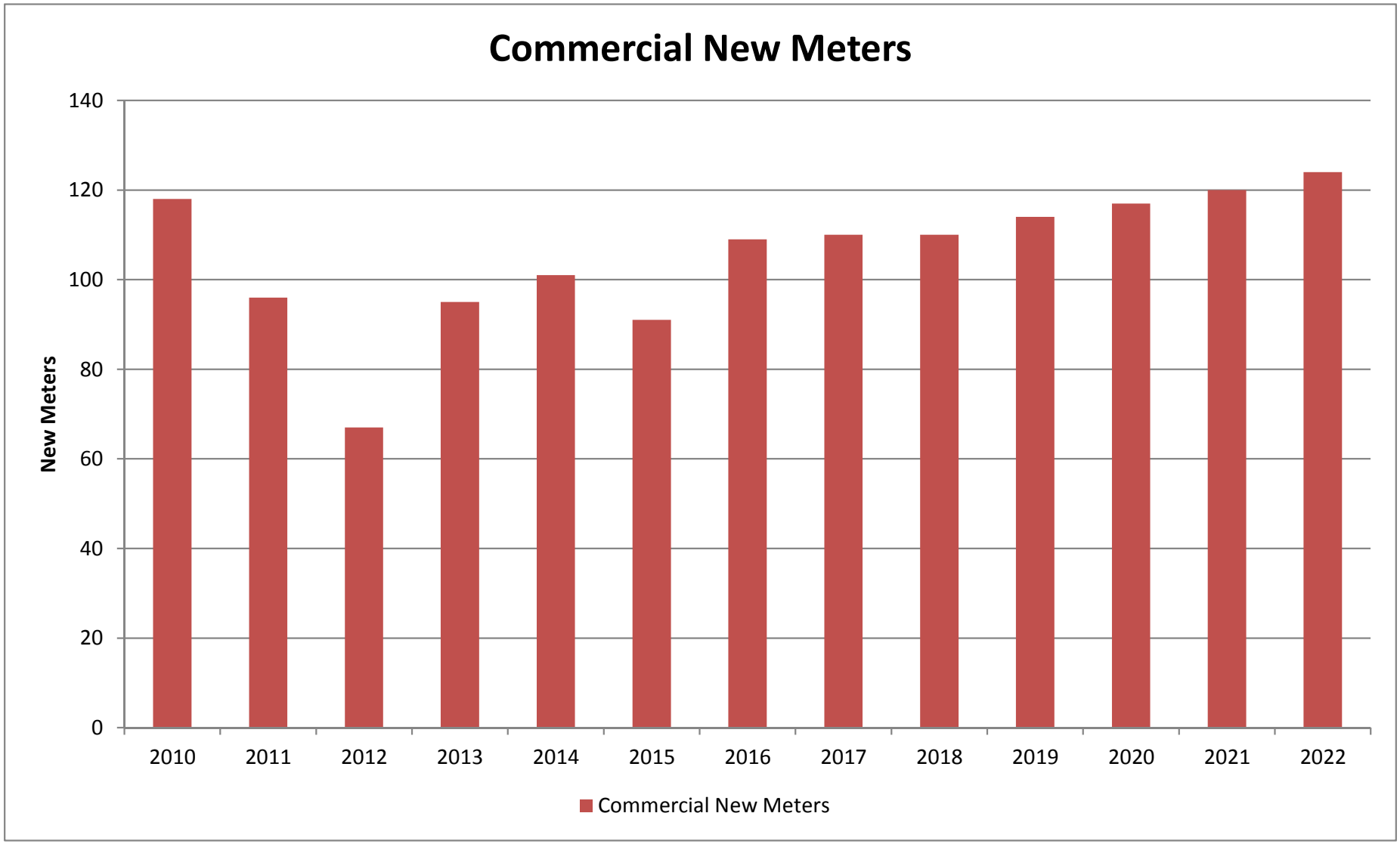
A. Total base revenue for the attrition period under current rates is projected to be $32.44 Million, with total revenue (including gas costs) of $71.24 Million.

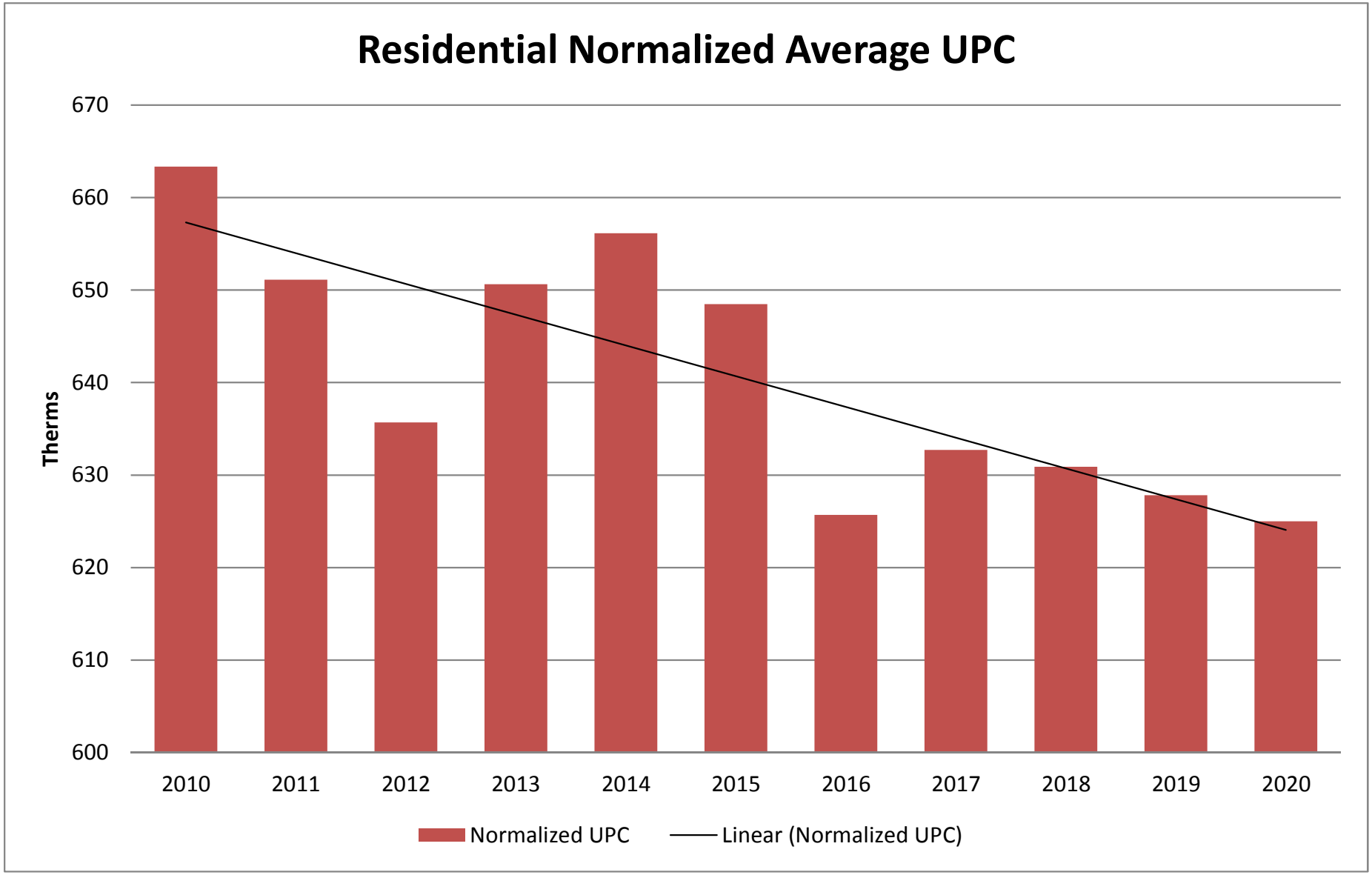
Q. Does this complete your direct testimony?

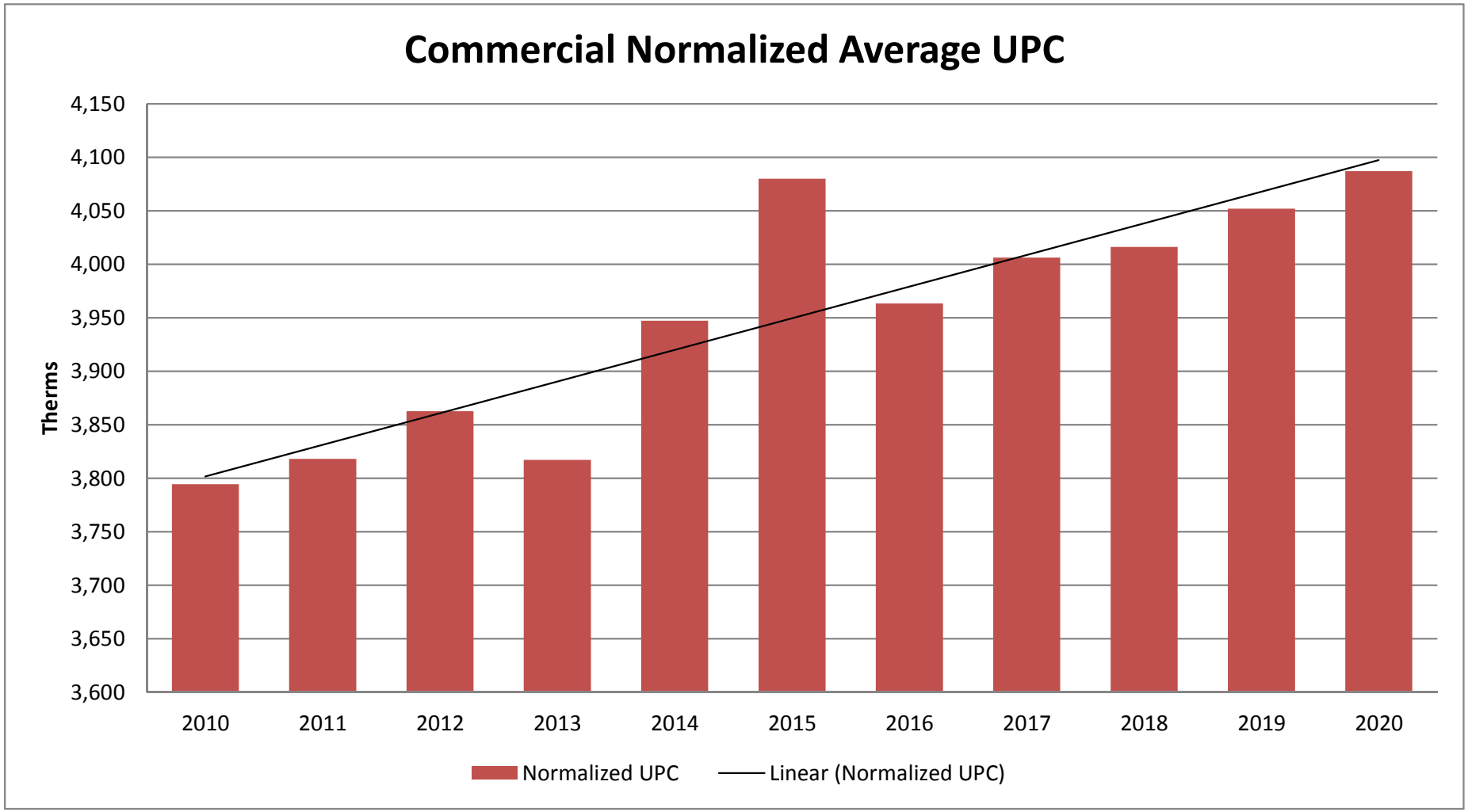
A. Yes.

Adjustment Number	Adjustment Title	Total Revenue		Gas Cost		Base Rate Revenue
	Test Year Total	**$ 68,115,720**		**$ 36,860,711**		
Adjustment 1	Removal of Unbilled	$ (243,571)		$ (180,738)		
Adjustment 2	Removal of AUA	$ (230,770)		$ -		
Adjustment 3	Removal of Non-Jurisdictional	$ (1,898,125)		$ (1,340,264)		
Adjustment 4	Growth Adjustment	$ -		$ -		
Adjustment 5	Normalization Adjustment	$ 3,157,012		$ 1,575,115		
	Test Year Total Adjustments	$ 784,546		$ 54,113		
	Test Year Normalized and Annualized	**$ 68,900,266**		**$ 36,914,824**		**$ 31,985,442**
Adjustment 6	Removal of Unbilled	$ -		$ -		
Adjustment 7	Removal of AUA	$ -		$ -		
Adjustment 8	Removal of Non-Jurisdictional	$ -		$ -		
Adjustment 9	Growth Adjustment	$ 2,336,002		$ 1,876,455		
Adjustment 10	Normalization Adjustment	$ -		$ -		
	Rate Year Total Adjustments	$ 2,336,002		$ 1,876,455		
	Attrition Year Normalized and Annualized	**$ 71,236,268**		**$ 38,791,279**		**$ 32,444,989**


Residential New Meters
Single Family Starts
New Meters
35000
30000
25000
20000
15000
10000
5000
0
1200
1000
800
600
400
200
0
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Residential New Meters
New Housing Starts


Commercial New Meters
New Meters
140
120
100
80
60
40
20
0
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Commercial New Meters


Residential Normalized Average UPC
Therms
670
660
650
640
630
620
610
600
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Normalized UPC
Linear (Normalized UPC)

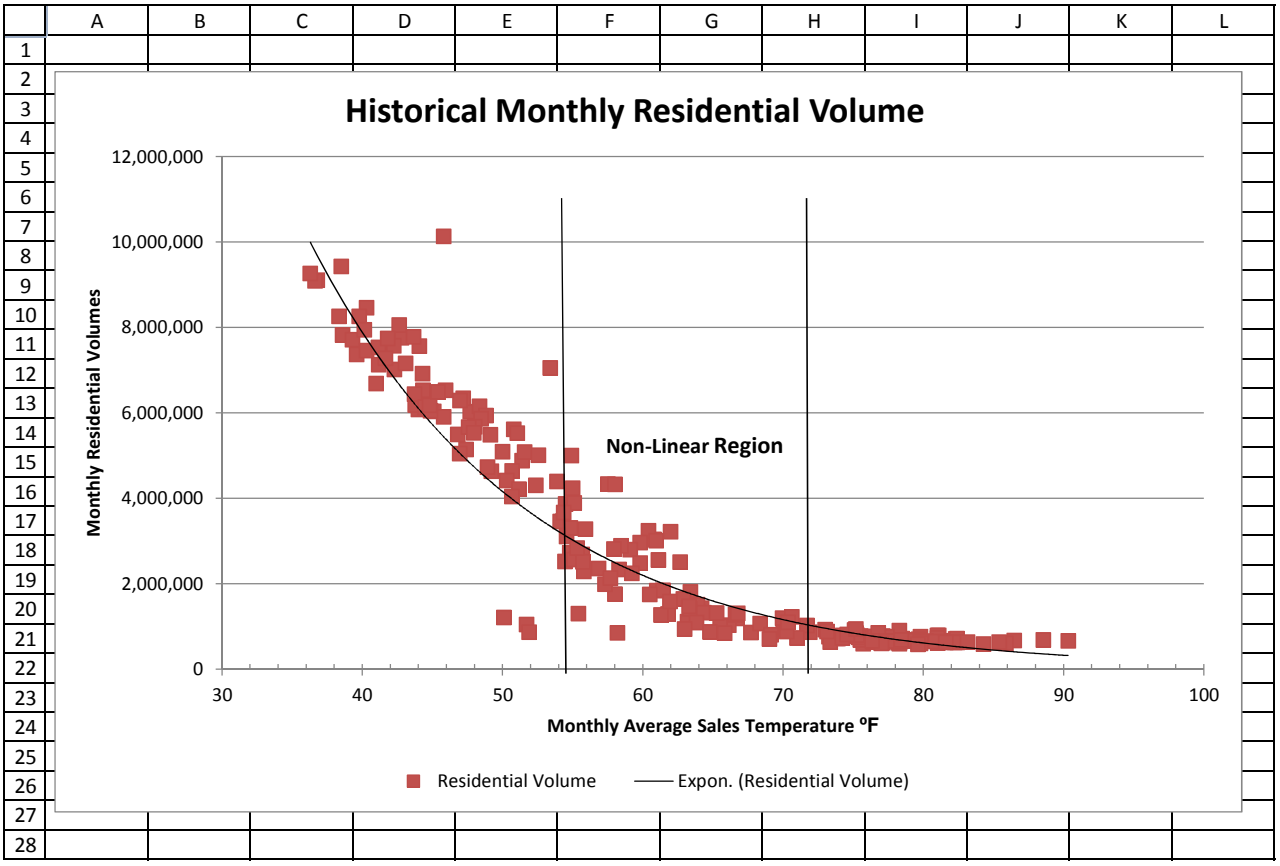

Commercial Normalized Average UPC
Therms
4,150
4,100
4,050
4,000
3,950
3,900
3,850
3,800
3,750
3,700
3,650
3,600
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Normalized UPC
Linear (Normalized UPC)

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	23	20	16	8	2	0	0	0	0	1	8	18	
2	22	19	15	7	2	0	0	0	0	1	9	17	
3	22	21	18	7	2	0	0	0	0	2	10	18	
4	23	23	16	7	3	0	0	0	0	2	11	18	
5	23	24	16	8	3	0	0	0	0	2	11	19	
6	23	24	14	8	2	0	0	0	0	2	12	20	
7	24	22	14	8	2	0	0	0	0	3	12	19	
8	26	20	14	6	1	0	0	0	0	3	12	19	
9	24	20	13	7	1	0	0	0	0	4	12	19	
10	24	22	14	6	1	0	0	0	0	3	12	19	
11	24	21	14	6	1	0	0	0	0	3	12	21	
12	22	22	13	5	1	0	0	0	0	4	13	21	
13	21	23	13	6	1	0	0	0	0	3	14	19	
14	23	20	13	4	1	0	0	0	0	3	14	20	
15	24	20	12	4	1	0	0	0	0	4	15	19	
16	25	20	12	5	1	0	0	0	0	5	14	20	
17	25	22	11	4	1	0	0	0	0	5	14	21	
18	24	21	10	4	1	0	0	0	0	5	14	22	
19	25	18	11	3	1	0	0	0	0	7	14	22	
20	24	16	11	3	1	0	0	0	0	7	13	22	
21	24	15	11	3	1	0	0	0	0	6	13	21	
22	25	16	12	3	1	0	0	0	0	6	15	21	
23	24	16	10	4	0	0	0	0	1	7	16	21	
24	23	18	9	4	0	0	0	0	1	7	16	23	
25	25	19	9	3	0	0	0	0	1	7	16	25	
26	23	19	10	3	0	0	0	0	1	6	16	24	
27	23	18	10	4	0	0	0	0	1	8	16	22	
28	22	17	8	3	1	0	0	0	1	8	17	21	
29	22		9	3	0	0	0	0	1	9	17	21	
30	22		8	2	0	0	0	0	1	8	16	22	
31	22		8		0		0	0		7		21	
Monthly Total (Non Leap Year)	726	556	374	148	32	0	0	0	8	148	404	635	3,031
Monthly Total (Leap Year)	726	572	366	142	30	0	0	0	8	148	404	635	3,031

July 1979 Through June 2009

Previous Rate Case Normal Degree Days

Monthly Total (Non Leap Year)	757	564	399	173	38	0	0	0	10	156	409	667	3,173
Monthly Total (Leap Year)	757	582	390	167	35	0	0	0	10	156	409	667	3,173


Historical Monthly Residential Volume
Monthly Residential Volumes
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
0
30
40
50
60
70
80
90
100
Non-Linear Region
Monthly Average Sales Temperature °F
Residential Volume
Expon. (Residential Volume)

HEATH J. BROOKS
RATE ANALYST – SOUTHERN COMPANY GAS

Mr. Brooks is an employee of Southern Company Gas and has served as a Rate Analyst since February 2016. Mr. Brooks provides regulatory support for Atlanta Gas Light Company (AGLC), Chattanooga Gas Company (CGC), Florida City Gas (FCG), Elizabethtown Gas (ETG), Virginia Natural Gas (VNG), and Elkton Gas. He is responsible for forecasting consumption, base revenues, and customer seasonality for annual budgets. He also performs the annual Designated Design Day (DDDC) calculation and review for CGC and AGLC, as well as the annual reclassification for CGC and FCG.

Relevant Project Experience

Regulatory Analysis, Forecasting

- Responsible for developing and updating the annual demand and revenue budget for CGC.
- Responsible for developing demand and revenue forecast for the 2017 VNG rate case.
- Responsible for the annual Basic Gas Supply Service (BGSS) demand forecast for ETG.
- Provided support for the ETG demand and revenue forecast for the 2017 rate case.

Education

Georgia State University – B.B.A. in Finance, *Magna Cum Laude*