

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

TESTIMONY OF

FRANK C. GRAVES

ON BEHALF OF
PHILADELPHIA GAS WORKS

DOCKET No. R-2017-2586783

February 2017

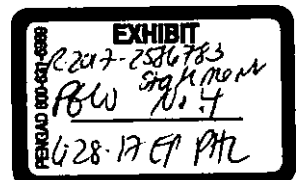


TABLE OF CONTENTS

I. Introduction.....1

II. Analysis Foundations.....8

III. Benchmarking Results27

IV. Projected Metrics With and Without Proposed Rate Increase.....47

V. Conclusions.....49

Appendix 1: Resume of Frank C. Graves51

Appendix 2: Supporting Figures.....87

**BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION**

1 I. INTRODUCTION

2 Q1. PLEASE STATE YOUR NAME, OCCUPATION, AND BUSINESS ADDRESS.

3 A1. My name is Frank C. Graves. I am a Principal at the economic consulting firm The
4 Brattle Group, where I am also the leader of the utility practice group. The Brattle
5 Group is located at 40 Brattle Street in Cambridge, Massachusetts.

**6 Q2. PLEASE SUMMARIZE YOUR EDUCATIONAL BACKGROUND AND
7 PROFESSIONAL EXPERIENCE.**

8 A2. I specialize in regulatory and financial economics, especially for gas and electric
9 utilities. I have over 30 years of experience assisting utilities in forecasting, valuation,
10 and risk analysis of many kinds of long range planning and service design decisions,
11 such as generation and network capacity expansion, supply procurement and cost
12 recovery mechanisms, network flow modeling, renewable asset selection and
13 contracting, and hedging strategies. I have testified before many state regulatory
14 commissions, including the Pennsylvania Public Utility Commission ("Commission"),
15 and the FERC, as well as in state and federal courts and arbitration proceedings, on
16 such matters as integrated resource planning (IRPs), energy contract disputes, the
17 prudence of utility investment and contracting decisions, risk management goals,
18 practices and outcomes, costs and benefits of new services, policy options for industry
19 restructuring, adequacy of market competition, and competitive implications of
20 proposed mergers and acquisitions.

21 In the area of financial economics, I have assisted and testified in civil cases in regard
22 to contract damages estimation, securities litigation suits, special purpose audits, tax
23 disputes, risk management, and cost of capital estimation, and I have testified in
24 criminal cases regarding corporate executives' culpability for securities fraud.

1 I received an M.S. with a concentration in finance from the M.I.T. Sloan School of
2 Management in 1980, and a B.A. in Mathematics from Indiana University in 1975. I
3 have included my detailed resume in Appendix 1.

4 **Q3. WHAT IS THE PURPOSE OF YOUR TESTIMONY?**

5 A3. My testimony benchmarks the financial performance of Philadelphia Gas Works
6 ("PGW" or "Company") over the 2011-2015 time period. This period covers most of
7 the time from the prior PGW rate case to the present, subject to the availability of
8 complete annual financial data on the companies reviewed. I analyzed both average
9 performance over that time period and also trends from its beginning to end. Through
10 the analysis, I will demonstrate that PGW's financial performance improved and then
11 stabilized following the 2009/10 rate case. However, the benchmarking also indicates
12 that PGW lags its peers on some key metrics such as debt to total capitalization
13 ("Debt/Capitalization") and days of cash on hand to cover operating expenses ("Days
14 Cash"). I also review the benchmarking metrics of financial performance that are
15 expected by PGW under the proposed rate increase. Although those projections are not
16 my primary focus, they show that there is a continuing need to support PGW's financial
17 stability with timely and appropriate rate increases, given the changes in required
18 accounting of the other postemployment benefits ("OPEB") liability that affect PGW's
19 balance sheet and cash requirements in the fully projected future test year (FPFTY) and
20 the subsequent Forecast Period (fiscal years 2019 through 2022).

21 **Q4. WHAT IS THE PURPOSE OF BENCHMARKING?**

22 A4. Benchmarking serves at least four purposes: satisfying Commission requirements,
23 establishing trends in PGW's performance, comparing those PGW trends and levels to
24 peers' performance, and identifying risk factors. Benchmarking involves reports on
25 recent past levels and trends for financial metrics that the Commission has stated
26 should be considered in ratemaking procedures. This is appropriate because one of the
27 goals of effective ratemaking -- complementary and equal to the goal of setting just and
28 reasonable rates -- is assuring financial viability for utilities, achieved by placing them
29 in parity with the financial performance being achieved by other companies and their

1 securities of similar risk. Benchmarking reveals how well that is being accomplished.
2 For this purpose, according to the Commission's Cash Flow Ratemaking Statement of
3 Policy, the Commission will consider year-end cash, short term borrowing capacity,
4 internal generation of funds to fund construction, debt to equity ratios, financial
5 performance of similarly situated utility enterprises, levels of operating and other
6 expenses, and levels of financial performance needed to maintain or improve PGW's
7 credit rating, amongst other relevant factors in deciding upon the financial
8 considerations in setting just and reasonable rates.¹

9 What is of interest in these metrics is whether PGW is improving and whether it has
10 reached threshold levels for financial health that have materially shifted (ideally,
11 improved) from past rate cases. As I discuss later, this is generally true for PGW, as it
12 has improved and stabilized somewhat over the past few years, but it has not achieved
13 levels that should be considered comfortable resting places.

14 While benchmarking does not project these values for the test-year and beyond, it
15 establishes current and historical industry-wide levels for these metrics. These indicate
16 whether PGW is improving or declining in financial health relative to desirable
17 thresholds and whether it is performing at a level comparable to peers. The relevant
18 metrics can also be derived in Company projections to see if its requested rate
19 adjustments accomplish reasonable ongoing performance.

20 Benchmarking assesses the significance of trends in performance by comparing metrics
21 from PGW to those of similarly situated peers over time (trends or longitudinal
22 analysis) and for a given snapshot of time (cross-sectional studies). Comparative trend
23 analyses help to determine how much of the changes in a utility's performance are due
24 to its own business operations and financial allowances or ratemaking practices versus

¹ The policy also states that the Commission will consider service quality, service reliability, and effects on universal service. I do not address these factors in my testimony here.

Pennsylvania Public Utility Commission, *Petition of Philadelphia Gas Works for a Statement of Policy on the Application of Philadelphia Gas Works' Cash Flow Ratemaking Method*, No. P-2009-2136508, § 69.2703.

1 being due to general participation in industry-wide trends, such as coming out of a
2 recession. For example, PGW's metrics could be improving, but PGW could still be
3 falling behind if it does not keep up with overall trends. By contrast, cross-sectional
4 analyses compare the value of a give metric across companies for just a single time
5 period or for value averaged across a few time periods. Unlike the performance trends,
6 this data does not focus on how performance has evolved over time but instead focuses
7 on the absolute level of performance. Both relative and absolute performance are
8 relevant to investors and lenders.

9 Finally, benchmarking can identify risk factors to PGW's future financial performance.
10 For example, a constant but highly levered financial structure, or an increasingly
11 levered financial structure, could increase risk to investors, result in a credit rating
12 decrease, and/or result in increased lending costs. Likewise, low liquidity levels and
13 high operating expenses could put a utility at risk for cash limitations during price
14 shocks. Benchmarking may not identify the shock, but it does indicate whether or not
15 the levels of liquidity are reasonable given norms and levels held by peers.

16 **Q5. PLEASE SUMMARIZE YOUR OVERALL APPROACH TO**
17 **BENCHMARKING AND TESTIMONY OVERVIEW.**

18 A5. My approach to benchmarking and its description in this testimony have five
19 components: (1) identifying a set of relevant benchmarking peers, (2) developing
20 metrics for benchmarking, (3) analyzing cross-sectional comparisons of metric values,
21 (4) identifying time-trends in metrics for the target utility versus its peers, and (5)
22 identifying risks based on benchmarking patterns and projections.

23 In Section II (Analysis Foundations), I will discuss the process of identifying peers and
24 the metrics used for the study of their performance in comparison to PGW. As
25 foundation, I will discuss the characteristics of PGW that make it unique amongst gas
26 utilities and that necessitate a wide group of benchmarking peers. Next, I will describe
27 the selection of three groups of utility peers for benchmarking, each which matches
28 some of the key PGW characteristics. These groups are composed of Pennsylvania
29 investor owned utilities (IOUs), non-Pennsylvania investor owned utilities with aging

1 urban infrastructures, and municipal utilities. None of course are perfectly analogous to
2 PGW, so I will comment on some differences that remain that may affect the
3 comparisons. In this section, I will also describe the categories of financial and
4 operating metrics that I use to compare these peer groups, and the relation of these
5 metrics to norms and thresholds used by credit rating agencies to evaluate the safety of
6 bonds. Since PGW relies exclusively on debt financing, satisfying reasonable credit
7 rating expectations is important to PGW's financial flexibility.

8 In Section III (Benchmarking Results), I will describe and discuss the results of the
9 benchmarking through cross-sectional and performance trend analyses. Although I will
10 review full results across all metrics, I will focus on three key metrics:
11 Debt/Capitalization, Days Cash, and debt service coverage ratios that do provide the
12 most significant financial information. As discussed in PGW Witness Hartman's
13 testimony, these ratios are also key indicators to credit rating agencies. I will show how
14 these ratios have improved since 2009/10 and their overall position relative to peers. I
15 also will show how these ratios interact with the Company's needs for capital
16 improvements to its distribution infrastructure.

17 Next, in Section IV (Projected Metrics with and without Rate Increase), I will consider
18 the impact of the proposed rate increase on key ratios to demonstrate the need for
19 continued financial stability and the beneficial impact on key ratios if the requested rate
20 increase is granted.

21 Finally, in Section V, I will present my conclusions based on both the historical
22 benchmarking analyses and the projected metrics with and without a rate increase.
23 Additional supporting figures follow the testimony.

24 **Q6. PLEASE SUMMARIZE YOUR CONCLUSIONS FROM THE STUDY.**

25 A6. PGW's financial health has improved substantially from levels it was experiencing
26 prior to the 2009/10 rate case, and with continued support from the Commission, it will
27 be able to maintain or improve this overall level of financial health. Conversely,

without that support, its financial strength could atrophy considerably, back to weak and constraining levels.

Below, in FCG Figure – 1, I have summarized three key financial metrics for PGW at four snapshots over time, first in financial year ending August 31, 2008 (prior to the 2009/10 rate case), then in the recent financial year ending in August 2015, the FPFTY ending August 31, 2018, and finally for the last year of the Forecast Period, ending August 31, 2022. The financial metrics for the projected years are shown both with and without the requested rate increase. The columns with the boxes around them are for the FPFTY.

FCG Figure – 1
Historical and Projected Financial Metrics

	Historical		Projected			
	2007/08	2014/15	2017/18	2021/22	2017/18	2021/22
Rate Increase Granted			\$0 MM	\$0 MM	\$70 MM	\$70 MM
Debt/Capitalization	85%	78%	96%	88%	91%	69%
Days Cash	24	74	34	-178	82	58
Debt Service Coverage (Principal & Interest)	1.01	1.29	1.24	1.44	1.92	2.08

Sources and Notes:

PGW-provided historical and pro forma financial statements; PGW Comprehensive Annual Financial Report 2011, 2012, 2013, 2014, 2015.

The fully projected future test year metrics with and without the proposed rate increase are shown as boxed. This year-end Days Cash metric varies from the corresponding amounts presented in Mr. Golden's testimony due to a variation in metric calculation. The Days Cash used in Mr. Golden's testimony removes amortized pension expenses from operating expenses. I do not exclude this amortized amount from the Days Cash metric because it is not feasible to make that same adjustment on all the benchmarking peers.

As seen in the first two columns of FCG Figure – 1, PGW's financial health improved following the rate increase granted by the Commission. Specifically, PGW's Debt Service Coverage (Principal & Interest) improved from 1.01 in 2008 to 1.29 in 2015,² while PGW's Debt/Capitalization correspondingly decreased from 85% in 2008 to 78% in 2015. Higher coverage means the debt is more immune from unfavorable revenue or

² Note that this metric is a standard formulation used for benchmarking that varies from the PGW's covenant calculation.

1 operating expense variances, while a lower debt ratio means that there are fewer
2 creditor claims against PGW per dollar of revenues and assets. However (but not
3 shown above) PGW is still more leveraged than most of its municipal peers and more
4 than all of its investor owned utility (IOU) peers. Also, PGW's Debt/Capitalization
5 will be increasing in the 2017 financial year as a result of revised OPEB accounting
6 requirements, which will reduce PGW's equity.

7 Another dimension that has improved since the last rate case is PGW's liquidity,
8 observed in the fact that its Days Cash metric grew from 24 days in 2008 to 74 days in
9 2015. But again, while this is a substantial improvement, PGW lags its municipal
10 peers, and it is below a normative level of around 100 days, which rating agencies
11 would likely require for PGW to improve its credit rating, and well below a target of
12 around 150 days ratings agencies expect for A to AAA rated companies (as discussed
13 in Mr. Hartman's testimony).

14 As shown in the first boxed column of FCG Figure-1 labeled "2017/18 \$0 MM,"
15 without the proposed rate increase both the capitalization ratios and Days Cash for
16 PGW would be at levels close to or worse in the FPFTY than they were in 2008. In
17 fact, without the rate increase, PGW's Days Cash would become negative in 2019 and
18 is projected to be significantly negative (-174 days) by 2022, the end of the Forecasted
19 Period. This circumstance would be untenable, requiring either a need to drastically cut
20 expenditures or to try to issue debt under highly unappealing circumstances. However,
21 in contrast, with the \$70 million proposed rate increase (seen in the second boxed
22 column), PGW's Days Cash is at a much healthier 83 days in the 2018 FPFTY and the
23 capital structure has begun to both recover from the loss of equity in the 2017 financial
24 year and improve by the end of the Forecast Period in 2022 to 69%. With the requested
25 rate increase, the 69% debt to total capitalization ratio at the end of the Forecast Period
26 is in line with the 70% debt to total capital ratio that Commission Staff have discussed
27 as not unreasonable (as I understand from Mr. Golden's testimony), and on the path to
28 achieving PGW's aspirational target of below 60% debt to total capitalization.

1 Maintaining or improving these ratios, as occurs with the rate request, is important to
2 achieving credit scores that allow reliable access to capital markets at low cost. As
3 discussed in Mr. Hartman's testimony, since 2010 PGW's credit rating has improved
4 from a Baa2 to Baa1 from Moody's, from BBB to BBB+ from Fitch, and from BBB+
5 to A from S&P. As a of the underlying rate increases that caused that result, PGW has
6 been able to pursue improvements in its infrastructure and meet growing obligations
7 and expenses. However, as noted PGW's ratings are closer but not to the level of its
8 utility peers, and PGW has significant future needs over the next few years for cash and
9 reliable borrowing capacity in order to achieve its ongoing planned upgrades in system
10 infrastructure. With approval of the proposed rates, PGW should be able to meet these
11 growing needs for capital and cash. That said, it is important to appreciate that this
12 requested increase and resulting outlook involves operating only slightly above a level
13 of financial health that could constrain the progress PGW has made or even cause it to
14 slide back to impaired access to capital, if there were any unplanned shocks that
15 increased funding needs or decreased receipts.

16 In short, my benchmarking analysis indicates that PGW's past rate increases have been
17 effective in improving its financial health and allowing more infrastructure
18 improvements, and that the requested rate increase is sized appropriately for continuing
19 that progress.

20 II. ANALYSIS FOUNDATIONS

21 Q7. PLEASE EXPLAIN HOW PEER GROUPS ARE SELECTED FOR 22 BENCHMARKING.

23 A7. Peer utilities are intended to provide a comparison group for benchmarking the
24 financial strengths and weaknesses of the target utility, and in order for this comparison
25 to be meaningful, peer companies should share similar financial and operating
26 characteristics that influence or constrain performance over time. The specific
27 characteristics used will be dependent upon the utility being benchmarked; however,
28 they may include physical characteristics of the system, customer profiles, regulatory
29 structures, financial structures, climate, or notable past events, such as storm damage or

1 bankruptcy. Availability of comprehensive and similarly compiled financial data will
2 also affect who can be a peer.

3 **Q8. WHAT CHARACTERISTICS MAKE PGW UNIQUE FROM A**
4 **BENCHMARKING PERSPECTIVE?**

5 A8. While PGW has many similarities to other gas utilities in terms of basic services and
6 principles it uses for pricing and cost recovery, PGW's size, density, age and type of
7 infrastructure, customer mix, and its financial structure, amongst other characteristics,
8 make it distinct in important ways that require benchmarking it with a few different
9 kinds of peers. For instance:

- 10 • PGW is the largest gas municipal in the country and one of the few that is solely
11 involved in gas services (as opposed to being a joint gas and electric company);
- 12 • Though a municipal utility, PGW is price-regulated by the Pennsylvania Public
13 Utility Commission rather than its city board, while its budgets and gas supply
14 plans are reviewed by the Philadelphia Gas Commission;
- 15 • Of the 100 largest gas munis in the US, PGW is the only one located in
16 Pennsylvania, and thus its muni peers face different regulatory and market
17 conditions;
- 18 • PGW has a denser, more residential, more low income customer base than many
19 similar sized utilities;
- 20 • PGW has a substantial quantity of old, cast iron pipe to replace; and
- 21 • PGW was in below-average financial health in 2009 (its last rate case) so even
22 with the economic recovery, it is not as strong as many similar utilities.

23 The characteristics important to choosing comparable peers for PGW are summarized
24 in FCG Figure – 2. Due to PGW's unique position, any peer selected will be
25 comparable on a subset of the characteristics. This necessitates a broad range of peers
26 and metrics, and not all metrics will be comparable to PGW's given the diversity of
27 characteristics.

FCG Figure – 2
Peer Selection Criteria

Characteristic	Match	Justification
Climate	MidAtlantic/East Coast, or Nationwide	Seasonal usage patterns and exposure to weather-related risk
Company Size	Total Revenues	Availability of financing products and risk levels
Customer Composition	Percentage Residential Send-Out	Seasonal usage patterns, exposure to weather-related risk, and extent of regulatory protection for vulnerable customers
Infrastructure Age	Percentage of Cast Iron Pipes	Capital investment requirements and operating costs
System Density	Customers/Mile	High unit cost of capital investments and operating costs
Regulatory Environment	Pennsylvania or Nationwide	Rate structures and regulatory requirements
Utility Type	Muni or IOU	Availability of financing products, ratemaking idiosyncrasies, and risk thresholds

Q9. HOW DID THE CHARACTERISTICS OF PGW INFLUENCE YOUR CHOICE OF BENCHMARKING PEERS?

A9. Because PGW is hard to compare on all relevant dimensions simultaneously to many other utilities, I have developed three groups of utility peers for comparison: Pennsylvania Investor Owned Utilities (“PA IOUs”), non-Pennsylvania investor owned utilities that are also urban systems with aging infrastructure and exposure to similar weather extremes as PGW (dubbed the Aging Urban Investor Owned Utilities “AU IOUs”), and municipals (“Munis”). Each of these groups was designed to be comparable to PGW across a subset of the criteria listed in FCG Figure – 2; the main criteria used to select each peer group are shown in FCG Figure – 3. For example, I developed the AU IOU group to be reflective of PGW’s physical infrastructure, selecting utilities for infrastructure age by the percentage of cast iron pipes and system density measured by customers per mile of main. On the other hand, the PA IOU group was developed to reflect similar regulatory oversight. I will note that where possible I restricted the peer groups to gas-only utilities, but in order to get sufficient breadth of

1 observations for meaningful comparisons, I had to include some gas-electric utilities or
 2 even electric-only utilities in a few cases. In those circumstances, I focus on financial
 3 performance metrics that largely exclude the effect of the type of commodity being
 4 sold.

5 **FCG Figure – 3**
 6 **Peer Group Characteristics**

Peer Group	Key Characteristics	
PA IOU	<ul style="list-style-type: none"> • Regulatory Environment (State) 	<ul style="list-style-type: none"> • Company Size
AU IOU	<ul style="list-style-type: none"> • Infrastructure Age • System Density • Climate 	<ul style="list-style-type: none"> • Customer Composition • Company Size
Muni	<ul style="list-style-type: none"> • Utility Type • Financing Practices 	<ul style="list-style-type: none"> • Company Size

7 **Q10. HOW WERE INDIVIDUAL UTILITIES SELECTED IN EACH OF THE**
 8 **GROUPS DESCRIBED ABOVE?**

9 A10. As the groups were developed to reflect different characteristics of PGW, I will discuss
 10 the selection of utilities on a group by group basis. In addition to the structural
 11 considerations for each group that I will explain in the following text, I limited my
 12 selection to peer utilities with financial data largely available across the 2011-2015 time
 13 horizon.

14 The development of the PA IOU peer group was tailored to reflect the regulatory
 15 environment that PGW operates within. This group of utilities is familiar to the
 16 Commission and likely to most interveners. To develop this peer group, I considered
 17 all 15 natural gas distribution companies regulated by the Commission in the state of
 18 Pennsylvania and then filtered to exclude those utilities that are not comparable or have
 19 financial anomalies due to mergers or other events. For similarity of size, I filtered this
 20 group to include only utilities with annual gas operating revenues exceeding \$100
 21 million across the time period of 2011 to 2015. As shown in FCG Figure – 4, which
 22 depicts both the total revenues and customer density of PA IOU group, this cuts out
 23 about half of the population, leaving seven gas distribution companies: Columbia Gas

(“Columbia”), National Fuel Gas Distribution (“National Fuel Gas”), PECO, UGI Central Penn Gas (“Central Penn”), UGI Penn Natural Gas (“Penn Natural Gas”), Peoples T.W. Phillips (“Peoples TWP”), and Peoples Natural Gas Company (“Peoples”).³ Compared to its peers in FCG Figure – 4, PGW is the largest of these from a gas revenue perspective with average annual gas revenues of about \$680 million, and PECO is the second largest, with average annual gas revenues of about \$590 million.

FCG Figure – 4
PA IOU Annual Gas Operating Revenues and Customer Density
(Average 2011-2015)

	Gas Operating Revenue (\$000)	Customer Density (customers/mile)
PGW	\$683,195	165
Central Penn	\$138,982	21
Columbia	\$504,575	57
National Fuel Gas	\$228,918	44
PECO	\$590,497	74
Penn Natural Gas	\$273,517	64
Peoples	\$387,668	53
Peoples TWP	\$94,756	23

Sources and Notes:

PGW Comprehensive Annual Financial Report 2011, 2012, 2013, 2014, 2015; Brattle analysis of SNL data.

Central Penn and Penn Natural Gas show averages for 2012-2015.

Peoples shows average for 2011-2013. Peoples TWP had gas revenues exceeding \$100M in 2011 and 2014. Residential, commercial, industrial, and all other customer types (as used in EIA 176 filings) included in customer count. Miles represent length of pipeline mains operated by each utility.

³ Dominion Peoples, Equitable Gas Company, and UGI Utilities were included in the 2009/10 benchmarking set. Dominion Peoples is no longer owned by Dominion and is included above as “Peoples.” Equitable Gas Company was excluded due to data unavailability following the 2013 merger with Peoples Natural Gas Company. UGI Utilities, Inc. acquired Central Penn (formerly PPL Gas Utilities) in October 2008 and acquired Penn Natural Gas (formerly PG Energy) in August 2006; these two subsidiaries are included, but the parent itself is excluded due to post-merger accounting anomalies.

1 While usefully similar, these utilities are mostly much less affected by older
2 infrastructure and have substantially lower customer density. PGW is the most
3 customer-dense system in Pennsylvania, as shown in FCG Figure – 4. Likewise, PGW
4 has the highest percentage of cast iron pipes of the PA IOUs.⁴ These two
5 characteristics most likely imply higher operating and maintenance costs to compensate
6 for maintaining the older infrastructure within a city environment, and to account for
7 higher capital spending requirements to replace the cast iron and uncoated steel pipes in
8 regions that may not be experiencing much customer growth to absorb the cost
9 increases, so I need to turn to a different peer group to find better proxies for that
10 consideration.⁵ These are described next.

11
12 **Q11. PLEASE DESCRIBE THE BASIS FOR THE AU IOU GROUP.**

13 A11. I developed the second peer group, the AU IOU peer group, to be comparable on an
14 infrastructure and a climate basis; that is, the gas infrastructure's age, composition, and
15 location within an urban area should be similar to PGW. Also, where possible I
16 focused on coastal, Atlantic cities for more similarity in weather conditions. In order
17 to identify utilities with these characteristics, I needed to consider utilities outside of
18 Pennsylvania.

19 To select the AU IOU peer group, I considered 62 candidate gas utilities located across
20 New England, the Mid-Atlantic, and other regions with potentially similar utilities. Of
21 this group, I selected those with similar size, percentage of cast iron mains, system
22 density, weather patterns and percentages of residential sendout. This process resulted
23 in the selection of five AU IOU peers: Baltimore Gas and Electric ("BGE"), Boston

⁴ According to a report by the Commission staff, PGW carried the highest percentage of at-risk pipeline by a factor of at least two compared to peers in Pennsylvania as of 2013. At that time, PGW operated approximately 1,500 miles of cast iron mains and an additional 493 miles of unprotected coated steel mains.

Pennsylvania Public Utility Commission, *Inquiry into Philadelphia Gas Works' Pipeline Replacement Program*, (Philadelphia, 2015), 19-20,
http://www.puc.pa.gov/NaturalGas/pdf/PGW_Staff_Report_042115.pdf

⁵ *Id* 4.

Gas Company ("Boston Gas"), Brooklyn Union Gas Company ("BUG Co"), Consolidated Edison ("ConEd"), and Public Service Electric and Gas ("PSEG"). As shown in FCG Figure – 5, these five companies had percentages of cast iron pipe on a mileage basis that range from 18% to 39% -- still below, but more comparable to 49% for PGW. PGW is in the middle of the AU IOU peer group for both customer density and percentage of residential sendout; however, it is one of the smaller companies in terms of revenue. Only BGE is smaller on a revenue basis. I also compiled information (not shown but discussed later) on their regulatory processes and rate structures for utilities within the AU IOU peer group. This information informs risk and may help explain their financial strength and/or relative position to PGW.

FCG Figure – 5
AU IOU Key Characteristics Group Comparability
(2011-2015 Averages)

	State	Gas Operating Revenue (\$000)	% Residential Total Sendout	% Mains: Cast Iron	Customer Density (customers/mile)
PGW	PA	\$683,195	49%	49%	165
BGE	MD	\$646,778	44%	18%	92
Boston Gas	MA	\$1,194,086	53%	32%	108
BUG Co	NY	\$1,507,483	62%	39%	294
ConEd	NY	\$1,565,613	23%	28%	250
PSEG	NJ	\$1,932,245	30%	23%	101

Sources and Notes:

PGW Comprehensive Annual Financial Report 2011, 2012, 2013, 2014, 2015; Brattle analysis of SNL data.

"%Mains: Cast Iron" denotes cast iron's share of total mileage of mains operated by each utility.

**Q12. THAT LEAVES THE MUNI PEERS. COULD YOU PLEASE DESCRIBE THE
 SELECTION OF UTILITIES FOR THIS GROUP?**

A12. The Muni group was needed to mirror the financial structure of PGW, since ratemaking for utilities is a bit different than for investor owned utilities. In particular, munis do not have investor equity, so their revenue requirements are driven largely by the need to satisfy financial obligations or guidelines (over a few years at a time) via debt solvency and liquidity performance targets that if satisfied, maintain their reliable, low cost access to debt capital (their only source of long term external financing). They must

1 collect more in revenues than their operating expenses, cost of interest, and
2 depreciation so that they have material debt service coverage and can accrue cash for
3 working capital contingencies in excess of due-course operating expenses. (IOUs
4 accomplish a similar goal by having an allowed return on equity, which is capital not
5 needing the same kinds of assured payback as debt. This usually assures that the debt
6 is secure.) However, munis are not all alike in the way they raise and support their
7 debt. Some (like PGW) are stand-alone entities covering their borrowings solely with
8 their own utility revenues, while others are more embedded in the financial structure,
9 needs and revenue sources of their municipality. I selected municipal utilities of
10 similar size with similar financing approaches.

11 To identify similar peers, I started with the eight largest gas municipal providers: PGW;
12 CPS Energy (TX, "CPS"); Memphis Light, Gas & Water (TN); Citizens Energy Group
13 (IN, "Citizens"); Metropolitan Utilities District (NE); Colorado Springs Utilities (CO,
14 "Colorado Springs"); Long Beach Gas and Oil (CA); and the Richmond Department of
15 Public Utilities (VA, "Richmond"). These utilities all have at least 100,000 customers;
16 however, I excluded Memphis Light, Gas and Water; Metropolitan Utilities District;
17 and Long Beach Gas and Oil because their financing is sufficiently different from
18 PGW's.^{6,7}

19 In addition the extent of available financial and operating data on municipals is more
20 heterogeneous and in some cases more limited than for IOUs. This stems from the fact
21 that municipals are generally regulated by their own boards or by their township, hence

⁶ Customer counts based on 2013 data.

"100 Largest Public Power Utilities by Electric Customers Served, 2013," *American Public Power Association*, accessed February 19, 2017

<https://www.publicpower.org/files/PDFs/100LargestPublicPowerUtilitiesbyElectricCustomersServed.pdf>.

⁷ At a high level, the financing and resulting ratios for these utilities are extremely different from others. Memphis Light, Gas, & Water ("MLGW") lacks a long-term debt track record; until August 2016, MLGW's gas division had not issued any bonds since 1984. Metropolitan Utilities District employs abnormally low levels of debt financing (debt/capital ratio <1% for 2011-2015). Long Beach Gas and Oil ("LBGO") reported negative change in net position for all five years in 2011-2015 as a result of operating transfers out.

1 they are not all required to submit standardized filings in the same manner as IOUs. As
2 a result and in order to form a larger benchmarking group, I extended the Muni group to
3 include three electric municipal utilities. Although these utilities provide a different
4 type of energy service, their financial performance should be similar to municipal gas
5 utilities because they are financed and set rates on the same basis, i.e. to maintain
6 adequate financial coverage against funding that is entirely driven by debt issues and
7 retained income. In my benchmarking, I also generally make comparisons using non-
8 commodity metrics. This means that although electricity supply service may have
9 different risk characteristics than gas, the differences are largely filtered out of the
10 metrics that I use, which focus more on distribution assets and their financing.
11 Comparing across different kinds of munis is also practiced by ratings organizations,
12 which use the same metrics to evaluate and compare municipal electric, gas, and water
13 utilities.⁸

14 There are more than 100 electric municipal utilities in the U.S. ranging in size from
15 those that serve more than 1.4 million customers to some serving fewer than 30,000. I
16 focused on utilities that have approximately the same number or somewhat fewer
17 customers than PGW; specifically, I started with customer counts no greater than
18 750,000 since PGW has approximately 500,000 customers.⁹ This excluded four
19 utilities and led to a group of six candidate utilities with customer counts over 400,000.
20 Upon further reviewing this group for comparable financing and data availability I
21 excluded three because they were already part of the benchmarking group (CPS), had
22 financing practices significantly different than PGW (MLGW), or had data availability
23 concerns (Austin Energy). As a result, I narrowed to a selection of three, specifically
24 the Sacramento Municipal Utility District ("SMUD"), Jacksonville Electric Authority
25 ("JEA"), and Seattle City Light ("Seattle City").

⁸ Peter Murphy, Jeffrey Panger, and Olga Kalinina, "Electric and Gas Utility Ratings," Standard & Poor's, December 16, 2014

Edward Damutz *et al.*, "US Municipal Utility Revenue Debt," Moody's, December 15, 2014

⁹ Philadelphia Gas Works, 2016 Audited Financial Report, p. 8

1 Combining the gas and electric utilities resulted in a group of seven muni peers. As
2 shown in FCG Figure – 6, this group of utilities includes two pure gas utilities, two
3 combined electric and gas utilities, and three pure electric utilities. This peer group
4 only includes utilities that issue bonds that do not have municipal backing.¹⁰ From a
5 gas revenue perspective, each of these peers is smaller than PGW; however, PGW is in
6 the middle of the group when considering both electric and gas revenue streams, as
7 shown in FCG Figure – 7. For example, Colorado Springs is smaller than PGW
8 considering only average annual gas revenues (about \$200 million annually compared
9 to \$680 million for PGW); however, Colorado Springs combined gas and electric
10 revenues are comparable to PGW's annual revenue (about \$615 million). That said,
11 there is a broad range across the Muni peer group; average total revenues for the Muni
12 group range from less than \$200 million to more than \$2.4 billion. This peer group is
13 not designed to include utilities with similar aging infrastructures in dense urban
14 environments, and as a result, they are not likely to be comparable on such measures as
15 how much liquidity they require for contingencies or for the size of capital expenditure
16 programs to upgrade their systems.

¹⁰ Technically, PGW bonds are issued by the City of Philadelphia, but they are purely revenue bonds backed by the PGW sales, not by any additional guarantees from the City.

FCG Figure – 6
Muni Peer Descriptions and Annual Revenues by Business
(2011-2015 Average)

	State	Muni Type	Gas Operating Revenue (\$000)	Electric Operating Revenue (\$000)
PGW	PA	Gas	\$683,195	n/a
Citizens	IN	Gas	\$285,048	n/a
Richmond	VA	Gas	\$152,406	n/a
Colorado Springs	CO	Gas + Electric	\$203,415	\$412,014
CPS	TX	Gas + Electric	\$207,381	\$2,111,482
SMUD	CA	Electric	n/a	\$1,434,838
JEA	FL	Electric	n/a	\$1,498,281
Seattle City	WA	Electric	n/a	\$852,950

Sources: PGW Comprehensive Annual Financial Report 2011, 2012, 2013, 2014, 2015; Brattle analysis of SNL data for Citizens; Brattle analysis of annual financial reports for Richmond, Colorado Springs, CPS, SMUD, JEA, Seattle City. Gas Operating Revenue marked n/a for electric-only utilities; Electric Operating Revenue marked n/a for gas-only utilities.

FCG Figure – 7
Muni Average Operating Characteristics
(2011-2015 Average)

	Total Operating Revenues (\$000)	Non-Commodity Operating Revenues (\$000)	Customer Count	% Residential Sendout
PGW	\$712,223	\$436,950	498,650	49%
Citizens	\$285,048	\$151,057	264,016	44%
Richmond	\$152,406	\$70,489	n/a	n/a
Colorado Springs	\$840,739	\$664,188	193,330	54%
CPS	\$2,318,863	\$1,520,921	333,953	43%
SMUD	\$1,434,838	\$1,163,294	609,103	n/a
JEA	\$1,498,281	\$913,635	429,482	n/a
Seattle City	\$852,950	\$625,850	409,870	n/a

Sources and Notes:

PGW Comprehensive Annual Financial Report 2011, 2012, 2013, 2014, 2015; Brattle analysis of SNL data for Citizens; Brattle analysis of annual financial reports for Richmond, Colorado Springs, CPS, SMUD, JEA, Seattle City.

Total Operating Revenues account for all services rendered by utility, including but not limited to electric, gas, water, and sewer. Non-Commodity Operating Revenues is the difference between Total Operating Revenues and purchased commodity costs. Customer count reflects number of gas customers for PGW, Citizens, Colorado Springs, and CPS (gas customer count not available for Richmond); customer count reflects number of electric customers for SMUD, JEA, and Seattle City. n/a denotes data unavailability for Richmond; % Residential Sendout not measured for electric utilities (i.e., SMUD, JEA, and Seattle City).

1 **Q13. ARE THERE CHARACTERISTICS OF PGW NOT CAPTURED BY THE**
2 **BENCHMARKING GROUPS?**

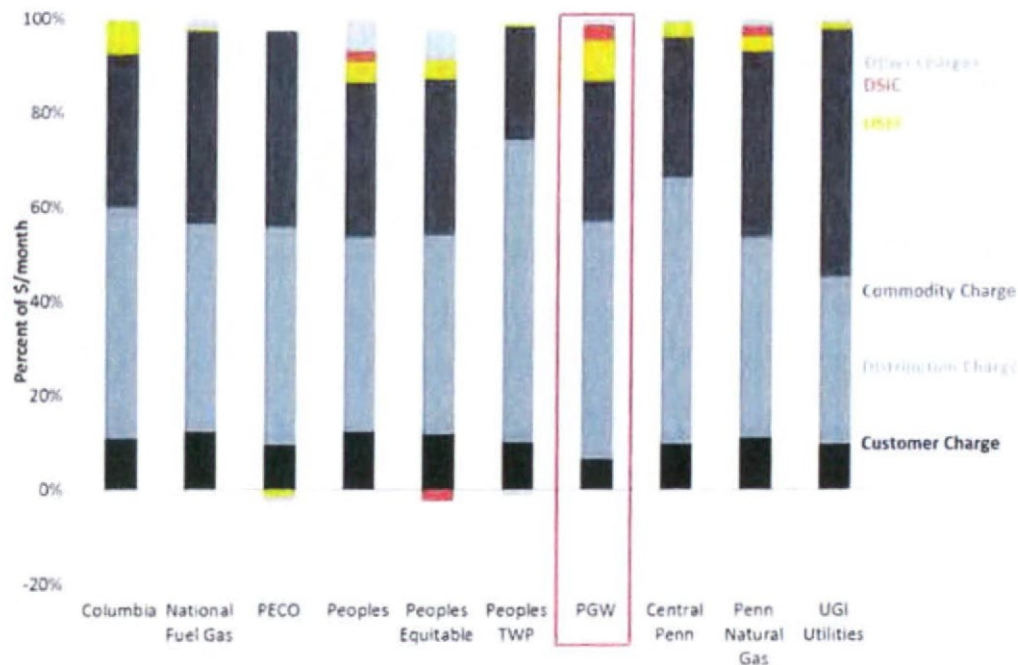
3 A13. Yes. PGW has a different financial basis for ratemaking than either set of the IOU
4 peers. PGW's ratemaking is based on a Cash Flow Ratemaking Method. That is, its
5 revenue requirements are determined by having adequate cash flow rather than by
6 having a target accrued return on equity. As a consequence, of the factors that the
7 Commission will consider; three of these may be especially critical to how PGW sets
8 rates: (1) levels of non-borrowed year-end cash, (2) capital structure (debt to equity and
9 related ratios), and (3) ability to satisfy bond covenants, which is measured by interest
10 and debt service coverage ratios .

11 PGW also has a larger emphasis on rate support for low income customers than other
12 PA IOUs.¹¹ This is evident in the income-support rates for PGW as compared to other
13 Pennsylvania utilities. Specifically, PGW has the largest Universal Service and Energy
14 Conservation charge, as a percentage of its PA peers, as shown in FCG Figure – 8 for
15 residential rates.

¹¹ Almost one in three households in Philadelphia qualifies as low-income.

"LIHEAP Opens Today and Philadelphia Gas Works Urges Low-Income Customers to Apply,"
Philadelphia Gas Works, accessed January 12, 2017. <http://www.pgworks.com/residential/about-us/newsroom/blog/liheap-opens-today-and-philadelphia-gas-works-urges-low-income-customers-to>.

FCG Figure – 8
Monthly Bill for Residential Heating Customer (15 mcf/month)



Sources and Notes:

2016 Pennsylvania Public Utility Commission Rate Comparison Report.

Note that Peoples Equitable and UGI Utilities are not included in our benchmark group but are included here for completeness. Only those DSIC charges actually incurred by customers in 2016 are shown above; Columbia, PECO, and Central Penn have also been approved for DSIC charges but did not levy DSIC charges in 2016.

PGW also has a relatively greater need to upgrade its infrastructure, which can also be inferred in part from the residential rates, as well as from information on pipe infrastructure.¹² PGW has the highest Distribution System Improvement Charge (DSIC), as a percentage of residential bills. The DSIC allows for accelerated capital investment in the gas distribution system. Three other PA utilities have DSIC charges: Peoples, UGI Penn Natural Gas, and Peoples Equitable. The last of the three, however, implemented a negative DSIC charge of 3.87% on August 1, 2015 to refund over-collection of DSIC revenues during an eight month period from July 2014 to March

¹² Over 2011-2015, cast iron mains represented 49% of the total mileage of mains operated by PGW. The 2011-2015 averages for peers are as follows: Columbia (2%), National Fuel Gas (3%), PECO (11%), Peoples (1%), Peoples Equitable (N/A), Peoples TWP (0%), Central Penn (0%), Penn Natural Gas (4%), UGI Utilities (6%). Data from Brattle analysis of SNL data.

1 2015.¹³ PGW's DSIC charge also differs from the other utilities' charges because it is
2 implemented on a pay-as-you-go ("PAYGO") basis, meaning that these costs are
3 recovered as expenses rather than as capital expenditures. This recovery is different
4 than many of PGW's other capital expenditure where the new assets are financed and
5 depreciated over decades, and it is also unlike IOUs, which place such assets in
6 ratebase and then earn a return on the underlying equity.

7 **Q14. ARE THE AVERAGE COSTS TO SERVE DEMAND COMPARABLE ACROSS**
8 **YOUR PEER GROUPS?**

9 A14. PGW's costs (exclusive of the energy commodity, gas or electricity, i.e., just its
10 distribution service costs) to serve demand are in the range of its AU IOU peers but are
11 somewhat higher than the PA IOUs. Insufficient data was available from the Muni
12 peer group to make comparisons meaningful.¹⁴ As shown in FCG Figure – 9, PGW's
13 2011-2015 average of \$4.46/mcf is in the upper part of the range of the AU IOU peer
14 set, which ranges from \$1.59 (PSEG) to \$4.58/mcf (Boston Gas). It is unsurprising that
15 PGW's costs to serve demand are more in line with the AU IOU peers since that group
16 was selected for system comparability, and these utilities are characterized by aging
17 infrastructure in an urban environment. The lower costs of PSEG and ConEd in the AU
18 IOU peer group may be influenced by the lower percentage of residential sendout
19 (giving them a higher average volume per customer, including non-residentials, hence
20 spreading their non-gas costs more thinly in my calculation). As shown previously in
21 FCG Figure – 5, ConEd and PSEG substantially differ on the percentage of total
22 residential sendout (ConEd 23%, PSEG 30%, PGW 49%).

¹³ Pennsylvania Public Utility Commission, *Peoples Natural Gas Company LLC – Equitable Division Supplement No. 31 to Tariff Gas – PA P.U.C. No. 46*, Docket No. P-2015-2486463, <http://www.puc.pa.gov/pdocs/1374658.pdf>

¹⁴ For combined electric and gas utilities, I only included the reported operating expenses for the gas business.

FCG Figure – 9
Non-Gas Operating Expenses per Volume of Total Sendout (mcf)
(2011-2015 Averages)

PA		AU IOU		Muni	
PGW	4.46	PGW	4.46	PGW	4.46
Central Penn	2.97	BGE*	3.27	Citizens	2.66
Columbia	2.33	Boston Gas	4.58	Richmond	n/a
National Fuel Gas	2.73	BUG Co	3.91	Colorado Springs*	n/a
PECO*	2.35	ConEd*	2.00	CPS*	n/a
Penn Natural Gas	1.91	PSEG*	1.59	SMUD	n/a
Peoples	2.93			JEA	n/a
Peoples TWP	2.08			Seattle City	n/a

Sources and Notes:

PGW Comprehensive Annual Financial Report 2011, 2012, 2013, 2014, 2015; Brattle analysis of SNL data.

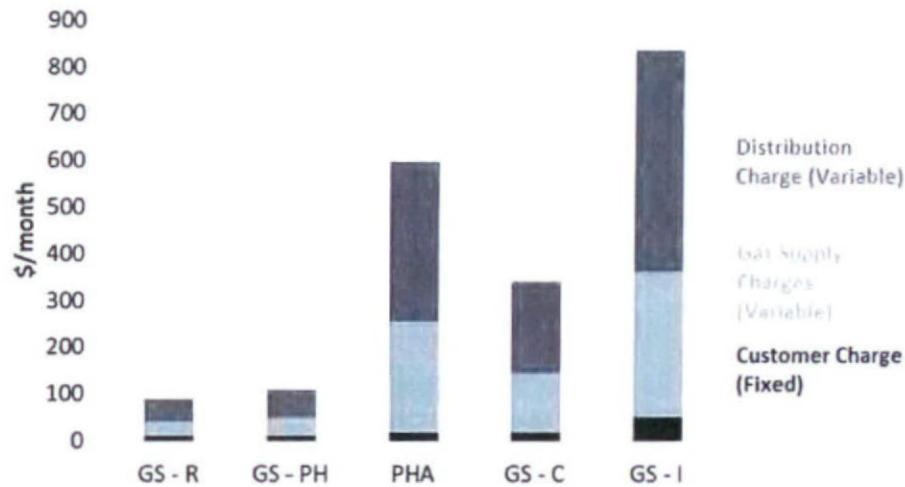
n/a reflects that either gas operating expenses were not reported separately from total operating expenses, or that volume data was not available. Gas operating expenses exclude purchased gas costs. Volume (mcf) measures total sendout. Asterisks (*) denote utilities providing services (e.g., electric) in addition to distribution of gas.

Q15. HOW DOES PGW'S RATE STRUCTURE COMPARE WITH ITS PA IOU PEERS?

A15. As shown previously in FCG Figure – 8, PA gas utilities have rate structures with low fixed monthly customer charges and high distribution charges that are billed on a per unit usage (variable) basis. All else held equal, a rate structure with low fixed charges implies more variance in utility revenues than a rate structure with higher fixed charges (hence more risk to creditors and investors). PGW has this same structure of low fixed cost and high variable charge pricing across its rate classes, as shown in FCG Figure – 10. Residential and commercial gas service accounts for the majority (73%) of PGW's revenues, and variable charges make up about 80% and 91%, respectively, of residential and commercial gas revenues to PGW. Across all rate classes except transportation, PGW's revenue is composed of approximately 80% variable charges and 20% fixed charges.¹⁵

¹⁵ Based on Brattle analysis of *City of Philadelphia, Pennsylvania Gas Works Revenue Refunding Bonds Fourteenth Series (1998 General Ordinance)* ("2015 Engineers' Report").

FCG Figure – 10
Illustrative PGW Non-Commodity Monthly Charges



Sources: Constructed using PGW rate and volume data from City of Philadelphia, Pennsylvania Gas Works Revenue Refunding Bonds Fourteenth Series (1998 General Ordinance) ("2015 Engineers' Report").

PGW's fixed customer charges per customer month are lower than the majority of its Pennsylvania peers. As shown in FCG Figure – 11, at \$12/customer-month PGW's residential customer charge is \$1.50/month below the 2016 average residential customer charge and more than \$4.00/month below Columbia's 2016 charge of \$16.75/month. PGW's commercial customer charge is more than \$10/month below the 2016 Pennsylvania average and more than \$45/month lower than the highest 2016 customer charge from Peoples TWP. In combination with having a large portion of its load being residential, this volumetric pricing likely makes PGW more exposed to financial (cash flow) variance from abnormal weather than its peers.

FCG Figure – 11
PA Residential and Commercial Customer Charges (\$/month)

	Residential		Commercial	
	6-yr. Average	2016	6-yr. Average	2016
PGW	\$12.00	\$12.00	\$18.00	\$18.00
Columbia	\$16.66	\$16.75	\$20.18	\$21.25
National Fuel Gas	\$12.00	\$12.00	\$27.53	\$27.53
PECO	\$11.75	\$11.75	\$28.55	\$28.55
Peoples	\$13.18	\$13.95	\$24.88	\$27.00
Peoples Equitable	\$13.25	\$13.25	\$28.00	\$28.00
Peoples TWP	\$14.14	\$15.75	\$62.36	\$65.00
Central Penn	\$14.46	\$14.60	\$29.34	\$30.40
Penn Natural Gas	\$13.18	\$13.17	\$32.43	\$32.41
UGI Utilities	\$9.08	\$11.75	\$9.79	\$16.00
Mean	\$12.97	\$13.50	\$28.11	\$29.41

Sources and Notes:

2016 Pennsylvania Public Utility Commission Rate Comparison Report.

Note that Peoples Equitable and UGI Utilities are not included in our benchmark group but are included here for completeness. UGI's customer charge increased in late 2016 and is reflected in the figures presented.

Q16. THUS FAR, YOU HAVE FOCUSED ON RATE STRUCTURE DIFFERENCES AND SIMILARITIES WITH THE PA IOU PEERS. ARE THERE ALSO REGULATORY TREATMENTS THAT DIFFER ACROSS THE AU IOU PEERS?

A16. Four of the five utilities in the AU IOU peer group have full decoupling. Generically, utilities with full decoupling have a lower risk profile, especially for cash flow, than those without decoupling because any revenue shortfalls in one period due to conservation and sometimes other causes are transferred and recovered (trued up) in future periods. However, these utilities may still encounter financial risks due to unanticipated expenses, such as higher than predicted operating and maintenance costs that are not covered by the decoupling true-ups. As shown in FCG Figure – 12, BGE, Boston Gas, BUG Co, and ConEd all have full decoupling.¹⁶ PSEG has partial

¹⁶ Utilities are considered to have full decoupling by Regulatory Research Associates if unexpected sales reductions are offset when caused by "energy efficiency programs, deviations from "normal" temperature patterns or economic conditions."

decoupling through weather normalization clauses.¹⁷ Within Pennsylvania, only Columbia and PGW have partial decoupling through weather normalization clauses.¹⁸ This partial decoupling reduces utility investment risk but to a lesser extent than full decoupling. Utilities without decoupling may need more cash on hand than utilities with decoupling.

FCG Figure – 12
Revenue Riders by Utility

State	Company	Peer Group	Gas Commodity	Conservation Program Expense	Decoupling		Generic Infrastructure
					Full	Partial	
PA	PGW	PA	Y	Y		Y	Y
PA	Columbia	PA	Y			Y	Y
PA	Peoples Equitable		Y				Y
PA	National Fuel Gas	PA	Y				
PA	PECO	PA	Y	Y			Y
PA	Peoples	PA	Y				Y
PA	Central Penn	PA	Y				Y
PA	Penn Natural Gas	PA	Y				Y
PA	UGI Utilities		Y	Y			
MD	BGE	AU IOU	Y	Y	Y		Y
MA	Boston Gas	AU IOU	Y	Y	Y		Y
NY	BUG Co	AU IOU	Y		Y		
NY	ConEd	AU IOU	Y		Y		
NJ	PSEG	AU IOU	Y	Y		Y	Y

Sources and Notes:

SNL Regulatory Research Associates, "Adjustment Clauses – A State-by-State Overview," 22 August 2016.

Generic Infrastructure include any infrastructure upgrade or replacement programs that authorize additional utility spending.

Q17. WITH THE PEERS SELECTED, PLEASE DESCRIBE HOW YOU SELECTED THE METRICS TO BE BENCHMARKED.

A17. Before selecting individual metrics for comparison, I developed four performance attributes to benchmark across PGW and its peers. All else held equal, a utility

¹⁷ SNL Regulatory Research Associates, "Adjustment Clauses – A State-by-State Overview," 22 August 2016.

¹⁸ Columbia's weather normalization clause was established in 2013 as a pilot program for residential customers that would continue until a final order is issued in the first rate case filed after May 31, 2016.

performing well across all of these attributes would be expected to be attractive to investors and have reliable, relatively low cost access to capital markets. Conversely, weak metrics could interfere with access to capital or raise the interest rate on available funds. With the categories defined, I then selected a few metrics that reflect each of these attributes. The benchmarking categories, shown in FCG Figure – 13, provide a holistic description of PGW's financial performance and comparison to peers. The calculation details for each metric are given in FCG Figure A – 1. In addition to these metrics, I also considered credit ratings for PGW and its peers. These ratings serve as a proxy for overall financial health and are themselves an indicator of PGW's financial performance.

FCG Figure – 13
Categories for Benchmarking Metrics

Attribute	Metric
Leverage & Risk	Profitability and default risk of the company
Liquidity	Ability to absorb unanticipated costs and finance capital investments
Solvency	Ability to pay debts
Turnover/Efficiency	Capital investment levels

The metric formulas identified in FCG Figure – 14 are generic measures, applied in a consistent fashion and not modified to reflect the calculation approaches that any individual utility may use for its own accounting or bond covenant purposes. I used this generic calculation approach to ensure that the utilities can be compared on an apples-to-apples basis.

FCG Figure – 14
Metrics Considered by Attribute

Attribute	Metrics
Leverage & Risk	<ul style="list-style-type: none"> • Debt / Capitalization • Operating Margin
Liquidity	<ul style="list-style-type: none"> • Days Cash • Internally Generated Funds/Revenues • Funds from Operation/Capital Expenditures
Solvency	<ul style="list-style-type: none"> • Funds from Operations/Debt • Funds from Operations Coverage • EBIT Coverage • Interest-Only Debt Service Coverage • Debt Service Coverage (Principal & Interest)
Turnover/Efficiency	<ul style="list-style-type: none"> • Capital Expenditures/(Depreciation + Amortization) • Net Plant/Gross Plant • Capital Expenditures/Net Plant

Q18. ARE THESE FINANCIAL METRICS COMPARABLE TO THE FINANCIAL METRICS USED BY CREDIT AGENCIES?

A18. The metrics credit rating agencies consider to determine a credit rating vary from agency to agency, though they are similar. The metrics I selected span the major financial performance attribute groups included by the three major credit agencies (Moody's, Fitch, and S&P) relating to solvency (leverage and risk), liquidity, profitability and the like. I understand from the testimony of Mr. Hartman on behalf of PGW that the three major metrics most important to rating agencies for evaluating munis include debt to equity ratios, debt service coverage, and Days Cash, and each of these metrics is included in my benchmarking set. As the investment risk profile varies by utility type, municipal versus IOU, the expected level on each of these metrics will vary and may carry different weight in the rating process. I have included a comparison of the metrics considered by the credit agencies as compared to the metrics in FCG Figure A – 2 and FCG Figure A – 3.

III. BENCHMARKING RESULTS

Q19. PLEASE GIVE AN OVERVIEW OF HOW YOU WILL DISCUSS YOUR BENCHMARKING RESULTS.

A19. I will explain my results in two major sections. First, I will provide a high level overview of how PGW's financial performance has evolved since 2009 as demonstrated through changes in its credit rating. Second, I will discuss the four categories of metrics (Leverage & Risk, Liquidity, Solvency, and Turnover/Efficiency) that both inform credit ratings and the overall financial performance of the Company. For each metric category, I will describe PGW's trends in performance as well as its average performance relative to the peer groups over the 2011-2015 time period. I have provided full supporting details for the calculations in FCG Figure A – 1.

Q20. HOW HAS PGW'S FINANCIAL PERFORMANCE EVOLVED SINCE THE LAST RATE CASE?

A20. PGW's financial performance began improving with the revenue increase granted in the 2009/10 rate case and it stabilized at these higher performance levels over the 2011-2015 time period, as shown earlier in my testimony in FCG Figure – 1. Consistent with these metrics, PGW's credit ratings improved one to two levels for each credit rating agency following the 2009/10 rate case, as shown in FCG Figure – 15.

**FCG Figure – 15
Improvement in Credit Ratings**

	Moody's	S&P	Fitch
2009	Baa2	BBB-	n/a
2015	Baa1	A-	BBB+

Sources and Notes:

2009 ratings from Exhibit FJH-1, Schedule 3, page 1 in the prepared direct testimony of Frank J. Hanley, CRRA (December 2009);
2015 ratings from PGW-provided credit rating history.

Q21. WITH ITS IMPROVED PERFORMANCE, IS PGW'S OVERALL FINANCIAL PERFORMANCE IN LINE WITH PEERS?

A21. Although PGW's financial health has improved, it has generally not kept pace (or caught up) with its peers on either the overall ratings or on the specific financial benchmarking metrics that I analyzed, especially with respect to leverage, solvency, and liquidity. PGW and most of its peers were affected by the recession and financial

stress that was in effect in 2009. Since then, most have improved and by 2015, PGW's credit rating from Moody's was closer to, but still lower than all IOU peers by 1-2 levels and similar on both Fitch and S&P ratings, as shown in FCG Figure – 16. However, compared to its Muni peers, PGW's 2015 credit rating from Moody's was lower by 4-6 levels. By comparison, all of PGW's municipal peers are Aa rated companies.

FCG Figure – 16
2015 Credit Ratings for Select Peers

Utility	Moody's	Fitch	S&P
IOUs			
PGW	Baa1	BBB+	A-
BGE	A3	BBB+	A-
Boston Gas Co	A3		
ConEd	A2	BBB+	A-
PECO	A2	BBB+	BBB
PSEG	A2	A-	BBB+
UGI Utilities	A2		
Munis			
PGW	Baa1	BBB+	A-
Colorado Springs Utilities	Aa2	AA	AA
CPS Energy	Aa1	AA+	AA
Jacksonville Electric Authority	Aa2		
Richmond Department of Public Utilities	Aa2	AA	AA
Sacramento Municipal Utility District	Aa3	AA-	AA-
Seattle City Light	Aa2		AA

Sources and Notes:

PGW-provided credit rating history: IOU ratings reflect LT (long-term) ratings from Bloomberg; muni ratings reflect most recent revenue bond ratings as recorded in EMMA (Electronic Municipal Market Access).
Blank denotes lack of rating in 2015.

Q22. CAN YOU DEPICT HOW PGW'S RATINGS HAVE IMPROVED RELATIVE TO ITS PEERS?

A22. Yes, but in order to do so I need to switch from relying on the similar but inconsistent letter grading that ratings agencies use to an equivalent numerical (ordinal, not cardinal) scheme. I developed this by assigning each credit rating a normalized numerical score in half point increments for all bond ratings considered investment

grade or above. This scale and the equivalent credit ratings across rating agencies are shown in FCG Figure – 17. A score below 5.5 in my scale would be below investment grade.

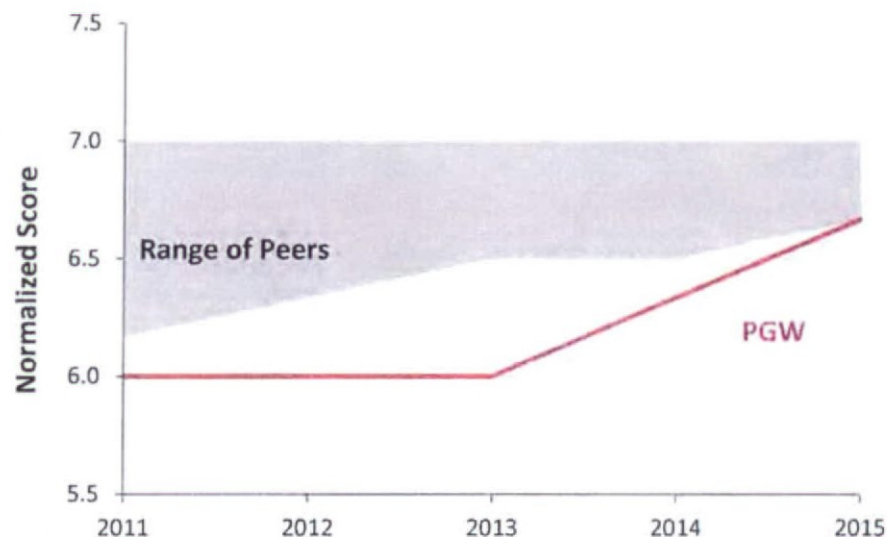
FCG Figure – 17
Credit Agency Rating Comparisons and Normalization

Moody's	Fitch	S&P	Score
Aaa	AAA	AAA	10
Aa1	AA+	AA+	9.5
Aa2	AA	AA	9
Aa3	AA-	AA-	8.5
A1	A+	A+	8
A2	A	A	7.5
A3	A-	A-	7
Baa1	BBB+	BBB+	6.5
Baa2	BBB	BBB	6
Baa3	BBB-	BBB-	5.5

Q23. GIVEN THAT NUMERICAL CONVERSION OF RATINGS, HOW DID PGW COMPARE TO ITS PEERS?

A23. FCG Figure – 18 below depicts the relative improvement of PGW compared to group of its IOU peers (PECO, BGE, Boston Gas, ConEd, and PSEG). As shown in FCG Figure – 18, PGW's normalized credit rating improved between 2013 and 2015, and the low end of its peers also improved; PGW's normalized credit rating reached the level of the low end of its peers in 2015. While relative position is not as important as absolute ratings, it is beneficial to be in the upper portion of your peer group rather than the lower, because when credit conditions tighten, there tends to be a "flight to quality" (giving superior access to the better performers).

FCG Figure – 18
Normalized Credit Rating for Select IOU Peers 2011-2015



Sources and Notes:

PGW-provided credit rating history; LT (long-term) ratings from Bloomberg.

Agency credit ratings normalized by Brattle numerical score. Ratings shown only for PECO, BGE, Boston Gas, ConEd, and PSEG. LT company-level credit ratings not available on Bloomberg for other IOUs; credit ratings at the parent company level not included.

Q24. HOW HAS PGW'S LEVERAGE CHANGED SINCE THE LAST RATE CASE?

A24. PGW has reduced its debt to total assets or total capital ratios through gains in customer equity since the 2009/10 rate case, which has likely helped increase credit ratings and lower borrowing costs. Generally speaking, when a utility operates with a higher percentage of debt relative to its peers, the cost of issuing debt increases. This occurs because the debt may be more risky to investors when the debt service represents a bigger claim against available cash flow. If there are actual equity shareholders as in an IOU but not a muni, using more debt also increases the volatility of the residual profits per dollar of equity. Greater leverage also affects value in the event of default, where a larger debt ratio means there is more risk that liquidated or restructured assets will not cover the full debt investment creditors have put into the company. Prior to the

2009/10 rate case, PGW had a 5-year average Debt/Capitalization of 84%.¹⁹ That leverage decreased to an average of 78% over the 2011-2015 time horizon.

Q25. IS THE PGW LEVEL OF DEBT NOW IN LINE WITH BENCHMARKING PEERS?

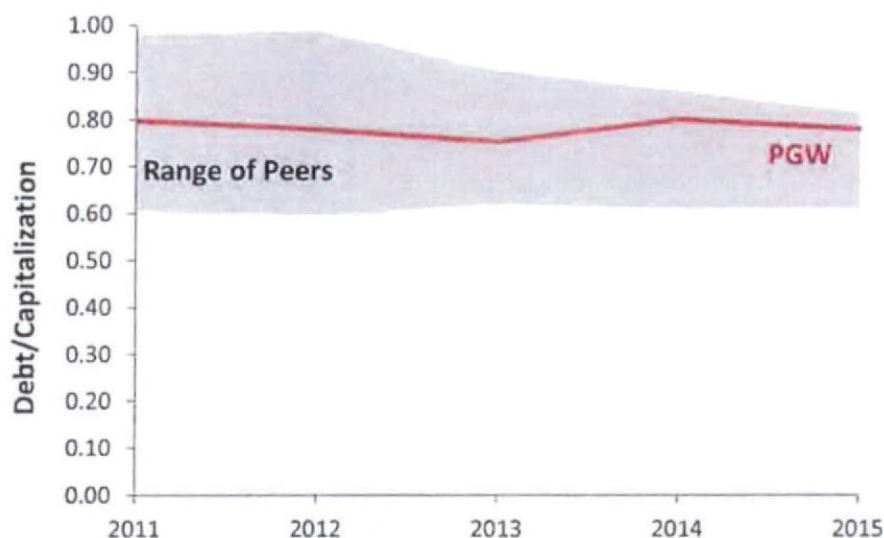
A25. PGW's Debt/Capitalization has improved from levels prior to the 2009/10 rate case at 85% in 2008 to a more desirable value of 78% in 2015. More generally over the 2011-2015 time period, compared to the Muni peer group, PGW had a slightly higher than average ratio (78% PGW, 73% average across all peers 2011-2015) of debt in its capital structure, but it was within the range of those Muni peers (from a low of 61% for CPS to a high of 91% for Citizens Energy, both values reflecting a 2011-2015 average).²⁰ The higher level of Debt/Capitalization at the Munis compared to IOUs is not surprising since municipal utilities are generally debt financed and so carry higher levels of debt than their IOU peers (which have equity investors). Compared to its PA IOU peers over the 2011-2015 time period, PGW is more levered, with PA IOU peers ranging from 36% (National Fuel Gas) to 50% (Peoples TWP) on average over the 2011-2015 time period. Similarly, the AU IOU peer group has 2011-2015 average Debt/Capitalization of 30% (Boston Gas) to 49% (ConEd).

While PGW's Debt/Capitalization has held relatively constant over the 2011-2015 time horizon, the general trend in the muni peer group has been toward lower Debt/Capitalization. As shown in FCG Figure – 19, the high-end of the Muni peer group's annual average Debt/Capitalization decreased from 98% to 81% between 2011 and 2015. While PGW is still in the range of its Muni peer group, it is now at the higher end of its peers.

¹⁹ Pennsylvania Public Utility Commission. *Prepared Direct Testimony of Frank J. Hanley, CRR, Docket No. R-2009-2139884*.

²⁰ All values reflect averages from 2011-2015.

FCG Figure – 19
Muni Peer Debt/Capitalization Ratios 2011-2015



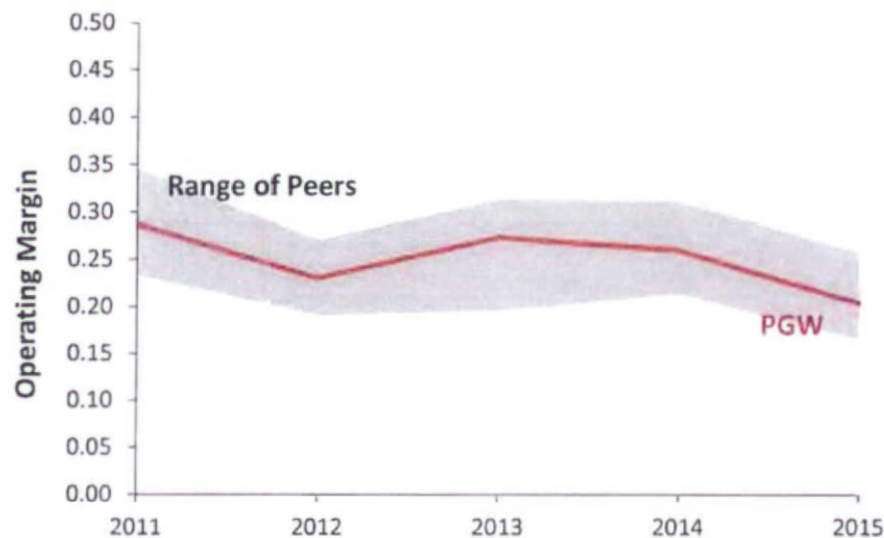
Sources: PGW Comprehensive Annual Financial Report 2011, 2012, 2013, 2014, 2015; Brattle analysis of SNL data for Citizens; Brattle analysis of annual financial reports for Richmond, Colorado Springs, CPS, SMUD, JEA, Seattle City.

Q26. HAS PGW'S PERFORMANCE LAGGED ON THE OTHER RISK & LEVERAGE METRIC CONSIDERED?

A26. PGW was largely in line with its peers for operating margins, the other risk and leverage metric that I considered. Operating margins are a proxy for firm profitability when normalized as the ratio of operating income to operating revenues. Higher operating margins indicate more cash flow for fixed costs, hence a lower risk profile as the utility has a greater buffer to cover costs and compensate debt and equity holders. Equivalently, having a higher margin means there is less sensitivity to variances in revenues for cash flow available for non-operating costs. PGW's 2011-2015 average operating margin (25%) was in line with both its PA IOU peers (ranging from 22-29%, average values over the 2011-2015 time period) and municipal peers (ranging from 17-35%, average values over the same time period). Both the PA IOU and Muni peer group margins were higher on average than the AU IOU peers (ranging from 15-26%, average values over the 2011-2015 time period). PGW's operating margin varied between 20% and 29% over the 2011 to 2015 time period, and these variations mirrored those in other PA utilities, as shown in FCG Figure – 20. Because these fluctuations are similar over time for PGW and the PA IOUs, they most likely reflect

weather-driven or macroeconomic revenue effects rather than variation in PGW's operational efficiency.

FCG Figure – 20
PA IOU Peer Operating Margins 2011-2015



Sources: PGW Comprehensive Annual Financial Report 2011, 2012, 2013, 2014, 2015;
Brattle analysis of SNL data for Columbia, National Fuel Gas, PECO, Central Penn, Penn
Natural Gas, Peoples, and Peoples TWP.

Q27. HOW DO PGW'S LIQUIDITY LEVELS COMPARE TO BENCHMARKED PEERS'?

A27. Liquidity is about having cash or ready access to cash-equivalent borrowings and securities on short notice. I developed metrics to look at liquidity in two different ways: availability to meet short-term funding requirements through the metric of Days Cash (year-end cash balance divided by average daily operating expenses including commodity costs but net of depreciation and amortization), as well as the ability to rely on funds internally generated by the company (from operations) to fund capital expenditures. In the period studied, PGW had lower liquidity than its peers on a Days Cash basis and comparable liquidity to its peers for capital expenditures. I will first discuss the Days Cash metric and then the metrics related to funds available for capital expenditures.

1 The Days Cash metric indicates how many days of operating expenses the utility could
 2 cover with its year end cash balances. I understand from Mr. Hartman's testimony that
 3 the median Days Cash for A to AAA ratings is 150 days. This level would allow a
 4 utility to keep covering its costs even if its receivables from customers were delayed for
 5 a few weeks, and it could also cover a month or more of higher than anticipated gas
 6 commodity purchases, e.g., during a colder than average month. In this example, the
 7 utility must have sufficient liquidity to cover the gas cost until the reimbursement from
 8 customers occurs.

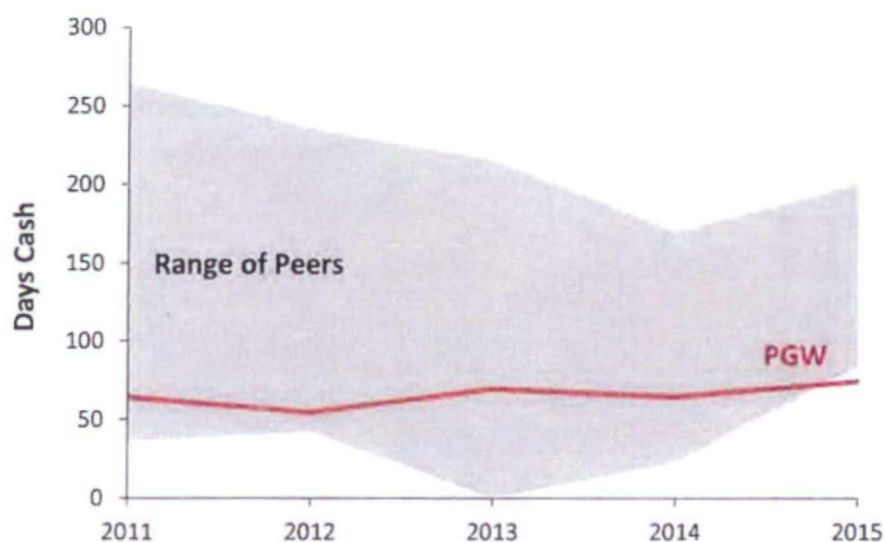
9 PGW had Days Cash on the low-end of the Muni peer group 2011-2015, and the Muni
 10 group generally had higher Days Cash than IOUs or PA IOUs.^{21,22} Specifically, PGW
 11 had a five year average 65 Days Cash on hand in 2011-2015, and over that same time
 12 horizon, the Muni peers ranged on average from 25 to 201 days. As shown in FCG
 13 Figure – 21, PGW's Days Cash was on the low-end of its Muni groups for each year
 14 from 2011-2015: it was also 35-78 days below the peer group average in every year
 15 2011-2015.²³ With fewer Days Cash, PGW was more exposed to short term liquidity
 16 risks than its Muni peers. In contrast, PGW had, on average, considerably higher Days
 17 Cash than its IOU peers. PA IOUs ranged from average Days Cash values 2011-2015
 18 of 4 to 114 Days Cash (average 31), and over the same time period, AU IOUs ranged
 19 from 2 to 25 Days Cash (average 10).

²¹ These Days Cash figures are inclusive of commodity costs and exclusive of depreciation and amortization.

²² It is important to note here that the municipal utilities have differing financial years that likely affect the year-end cash balances. A utility with a financial year ending in the winter would generally be expected to have less cash on hand due to payment for commodity costs not yet recovered from ratepayers. On the other hand, a utility such as PGW with a summer or early fall financial year (September-August) would generally be expected to have greater cash on hand. Peer Munis have the following financial years: Citizens (January-December), Richmond (July-June), Colorado (January-December), CPS (February-January), SMUD (January-December), JEA (November-September), Seattle City (January-December).

²³ In 2011, PGW had 64 Days Cash; the peer group Days Cash average was 136. In 2012, PGW had 54 Days Cash; the peer group Days Cash average was 133. In 2013, PGW had 69 Days Cash; the peer group Days Cash average was 116. In 2014, PGW had 64 Days Cash; the peer group Days Cash average was 99. In 2015, PGW had 74 Days Cash in 2015; the peer group Days Cash average was 125.

FCG Figure – 21
Muni Peer Days Cash 2011-2015



Sources: PGW Comprehensive Annual Financial Report 2011, 2012, 2013, 2014, 2015;
 Brattle analysis of SNL data for Citizens; Brattle analysis of annual financial reports for
 Richmond, Colorado Springs, CPS, SMUD, JEA, Seattle City.

Q28. PLEASE DISCUSS WHY THE DAYS CASH METRIC IS NOT SO COMPARABLE BETWEEN MUNICIPAL UTILITIES AND IOUs?

A28. Comparing liquidity levels on a Days Cash basis between municipal utilities and IOUs is complicated by the differing financing strategies and access to short term financing. IOUs may need to carry fewer cash reserves than municipals due to intercompany pools, since many of them are subsidiaries of a larger holding company which frequently has access to a cash reserves at the holding company level. These can be less expensive than external financing that smaller, less diversified munis might need to do, both because of scale and because of diversity across many lines or locations of business. (Because cash needs probably are not perfectly correlated across all subsidiaries, the total amount required by the holding company per dollar of assets may be less.) I am aware that 8 of the 12 peer IOU utilities in the benchmarking study have access to cash pooling arrangements, and the other 4 may have access to pooling arrangements.²⁴

²⁴ The 8 of 12 peer IOUs have access to cash pooling arrangements: Columbia Gas, National Fuel Gas,

1 In addition, several of the IOUs in the peer groups have regulatory mechanisms that
2 help them maintain steady cash levels even if they experience variances. In particular,
3 as noted in my introductory description of the peers, several have decoupling, which
4 helps immunize them against reductions in sales. This helps reduce their need for cash
5 balances.

6 By contrast, municipal utilities do not have access to the same types of financial
7 pooling (in a holding company) and may also require a more fixed quantity of cash on
8 hand due to political or structural considerations in budget setting. Unlike IOUs,
9 budgets and financing plans for municipal entities may be set or require approval by a
10 board or other entity at irregular intervals, via a complex political review process, and
11 so they may have inherently less flexibility than an IOU. Without this flexibility,
12 municipals may need to have more conservative (higher) levels of cash available.
13 Finally, municipals may need to carry larger cash balances if they do not have a
14 sufficiently large debt service reserve fund.²⁵

15 **Q29. WAS PGW BELOW PEER LEVELS IN REGARD TO INTERNAL FUNDS**
16 **AVAILABLE FOR CAPITAL EXPENDITURES?**

17 A29. PGW's comparison to peer groups on liquidity for internally funding capital
18 expenditures is not as clear as the Days Cash comparison. Here, PGW's health was on
19 par with peers on one metric and higher than most non-PA peers on another. For this
20 comparison, I considered the ratio of internally generated funds (IGF) to revenues as
21 well as funds from operations (FFO) to capital expenditures ("CapEx"). The first
22 measure describes what percentage of pre-tax revenues could be available as cash for
23 investment, and the second provides insight as to the extent to which a utility needs to

PECO, Central Penn. Penn Natural Gas, BGE, ConEd, and PSEG. Columbia Gas, National Fuel Gas, BGE, and ConEd make no explicit references to cash pooling but have dividend arrangements and/or cross-default provisions with their holding companies that may include some form of ad hoc cash sharing.

PGW 2015 Comprehensive Annual Financial Report; NiSource 2015 10-K; National Fuel Gas Company 2015 10-K; Exelon 2015 10-K; UGI Corporation 2015 Annual Report; Con Edison 2015 Annual Report; PSEG 2015 10-K.

²⁵ Edward Damutz *et al.*, "US Municipal Utility Revenue Debt," Moody's, December 15, 2014, 13

3 **FCCG Figure – 22**
4 **Financial Definitions for Liquidity**

Notes: Purchased commodity costs excluded from Operating Revenues in IGF/Revenues metric.
If cash flow statement was not available, CapEx was calculated according to the following:
Current Year Property, Plant, Equipment (PPE) - Previous Year PPE + Current Year
Depreciation.

6 Comparing FFO to CapEx, PGW's 5-year average value (1.05) is on the higher end of
7 the Muni peer group (0.68-2.72) as four of the seven peers have FFO/CapEx ratios of
8 less than one. Likewise, PGW has higher internal funding than all utilities in the AU
9 IOU peer group, which all have 5-year average FFO/CapEx ratios of less than one
10 (0.56-0.85). In the PA IOU peer group, 5-year average FFO/CapEx ratios range from
11 0.51 (Columbia) to 1.75 (National Fuel Gas), and PGW is slightly below the 5-year
12 average group average of 1.07.

²⁷ All numbers cited reflect an average over the 2011-2015 time period.

**Q30. WHAT IS YOUR OVERALL CONCLUSION ABOUT PGW'S LIQUIDITY
VERSUS ITS PEERS?**

A30. Over the 2011-2015 time period, PGW's Days Cash and internal funding were both comparable to IOUs, but both measures were a bit low compared to Munis. Of these peer groups, the municipal comparison is the more apt and important one. PGW's somewhat low cash might not be a problem if there are no "hiccups" in operations over the next few years, but it leaves the Company with less flexibility or resiliency than other Munis may enjoy and ratings agencies may recommend. I understand that the proposed rate increase is targeted in large part to address this.

**Q31. GIVEN DIFFERENCES IN FINANCIAL STRUCTURE AND
REQUIREMENTS, HOW DID YOU COMPARE SOLVENCY ACROSS THE
BENCHMARKING GROUPS?**

A31. Solvency refers to how much confidence creditors can have in the ability of their borrowers to meet their debt service obligations. This is measured by variations on metrics that compare alternative layers of operating income to interest expense or debt service, possibly by level of subordination. Often these are measured directly the way bond covenants are specified, since default can be triggered if some solvency ratios fall below minimum thresholds. However, those covenant-based metrics are particular to each company and not always public, so instead of using these, I developed five generic metrics that reflect solvency across firms on an apples-to-apples basis. These metrics, shown below in FCG Figure – 23, reflect multiple measures of funds available to cover debt and three debt measurements.

FCG Figure – 23
Financial Definitions for Solvency

Operating Income	Debt
FFO	Net Income + Depreciation + Amortization
EBIT	Net Income + Interest + Taxes
FFO/Debt	(FFO) / 2-Year Average Total Debt
FFO Coverage	(FFO + Interest) / Interest
EBIT Coverage	(Net Income + Interest + Taxes) / Interest
Interest-Only Debt Service Coverage	(Operating Income + Depreciation + Amortization + Interest Income) / Interest
Debt Service Coverage (Principal + Interest)	(Operating Income + Depreciation + Amortization + Interest Income) / (Interest + Principal Paid on Long-Term Debt)

Notes: 2-Year Average Total Debt is the two-year average of the sum of long-term debt and short-term debt.

Q32. HOW DOES PGW STAND ON THESE MEASURES OF SOLVENCY IN ABSOLUTE TERMS, RELATIVE TO ITS COVENANTS?

A32. Prior to 2015, PGW had outstanding long-term debt issued under a 1975 Ordinance and a 1998 Ordinance.²⁸ Both the 1975 Ordinance and the 1998 Ordinance required a debt service coverage ratio of 1.5x, and this coverage ratio was calculated separately for debt issued under each ordinance. As the senior bond, the debt service coverage ratio for the 1975 Ordinance debt in August of 2008 was 4.28, and this improved to 6.57 in August of 2015. While improved, this ratio is somewhat misleading as the size of the debt service reduced as 1975 Ordinance debt was retired. The debt service coverage ratio for the 1998 Ordinance debt is more indicative of overall health, and it improved from 1.88 in August of 2008 to 2.14 in 2015. Typically, PGW reports the debt service coverage ratio for all long term debt. This “aggregate” debt service coverage ratio also improved from 1.53 in August 2008 to 1.82 in August 2015.

Q33. WHY DOES THE AGGREGATE CALCULATION SHOW A LOWER DEBT SERVICE COVERAGE RATIO THAN EITHER OF THE INDIVIDUAL ORDINANCES?

²⁸ There is no 1975 Ordinance debt outstanding as of August 31, 2015.

Philadelphia Gas Works, Comprehensive Annual Financial Report for the Fiscal Year Ended August 31, 2015.

1 A33. The coverage ratios for individual ordinances are higher than the aggregate coverage
2 because the separate calculations allow a single dollar to provide coverage for both
3 ordinances. PGW first calculates the coverage ratio for the 1975 Ordinance debt using
4 all available funds to cover debt service. To calculate the funds available for coverage
5 of the 1998 Ordinance debt, PGW then takes all funds available to cover debt service
6 and subtracts the 1975 debt service requirements; this subtraction includes only the
7 interest and principal payments for the 1975 Ordinance debt. It does not include the
8 additional funds required to meet the 1.5x coverage ratio under the covenant. As a
9 result, funds "used" to meet the 1.5x ratio for the 1975 Ordinance debt are also counted
10 as available to meet coverage requirements for the 1998 Ordinance debt.

11 On the other hand, when the aggregate debt service coverage is calculated, all debt is
12 considered at once, and as a result, a single dollar may only be counted towards both
13 debt service coverages once. This produces a lower overall aggregate debt coverage
14 ratio. Historically, an aggregate debt service coverage ratio of 1.5 has correlated with a
15 debt service coverage for the 1998 Ordinance debt of approximately 1.75-2.0.

16 **Q34. WHICH OF YOUR METRICS IS MOST CLOSELY ALIGNED WITH PGW'S**
17 **AGGREGATE DEBT SERVICE COVERAGE RATIO?**

18 A34. Of the metrics I considered, the Debt Service Coverage (Principal & Interest) metric
19 most closely aligns with PGW's aggregate debt service coverage ratio. My Debt
20 Service Coverage (Principal & Interest) metric is lower than PGW's aggregate debt
21 service coverage ratio due to revenue recognitions in PGW's coverage ratio that we
22 cannot imitate in applying such a test to its peers.

23 **Q35. HOW DO PGW SOLVENCY MEASURES COMPARE TO THE PA OR AU**
24 **IOUS?**

25 A35. On the solvency metrics that I considered, IOUs (PA IOUs and AU IOUs) generally
26 had stronger solvency metrics than municipalities (including PGW) in the benchmarking
27 groups. For example, the FFO/Debt ratios for IOUs (averaged 2011-2015) ranged from
28 0.18 (Peoples Division) to 0.49 (Boston Gas), while the Munis' range was lower, from

1 0.06 (Richmond) to 0.12 (Citizens). Over the same time period, average FFO Coverage
2 ratios for IOUs ranged from 3.55 (Penn Natural Gas) to 7.88 (Boston Gas), while
3 Munis went from 2.16 (PGW) to 3.7 (Seattle).²⁹ This difference between Munis and
4 IOUs was unsurprising because municipalities are more highly leveraged and thus have
5 higher debt levels to cover.³⁰ The absolute levels for PGW and its comparisons to
6 munis are probably more significant on these measures..

7 **Q36. DOES YOUR BENCHMARKING INDICATE THAT PGW'S SOLVENCY HAS**
8 **IMPROVED TO THE LEVELS OF ITS MUNI PEERS?**

9 A36. PGW lagged its Muni peer group in each solvency metric considered excluding Debt
10 Service Coverage (Principal & Interest). As shown in FCG Figure – 24, PGW had the
11 lowest average FFO Coverage and Interest-Only Debt Service Coverage in the Muni
12 peer group and FFO/Debt and EBIT Coverage were below average. While PGW did
13 not lag its Muni peers on the Interest & Principal Coverage metric, there may be
14 idiosyncratic financing reflected in this measure as both Richmond and SMUD appear
15 to have ratios below 1.0, which would indicate that the utilities were unable to cover
16 their interest and principal payments.

²⁹ Likewise, Penn Natural Gas had an FFO Coverage ratio of 3.55; this ratio is lower than Seattle (3.7) and equal to Colorado Springs (3.55). Penn Natural Gas had a lower Interest-Only Debt Service Coverage ratio than four Muni peers. Peoples had a lower Interest-Only Debt Service Coverage ratio than one muni peer.

³⁰ The relative performance of PA IOUs to Munis on Debt Service Coverage (Principal & Interest) is difficult to assess due to data availability.

FCG Figure – 24
Muni Peer Group Solvency Metrics
(2011-2015 Average)

	FFO to Debt	FFO Coverage	EBIT Coverage	Interest-Only Debt Service Coverage	Debt Service Coverage (Principal + Interest)
PGW	0.07	2.16	1.91	2.45	1.39
Citizens	0.12	3.22	2.40	3.27	NA
Richmond	0.06	2.57	1.36	2.71	0.99
Colorado Springs	0.09	3.55	2.51	3.47	1.30
CPS	0.08	2.95	2.68	3.97	2.09
SMUD	0.09	3.40	1.97	3.18	0.91
JEA	0.09	3.17	2.19	3.60	1.59
Seattle City	0.11	3.70	3.38	3.07	1.38
Peer Average	0.09	3.22	2.35	3.32	1.38

Sources and Notes:

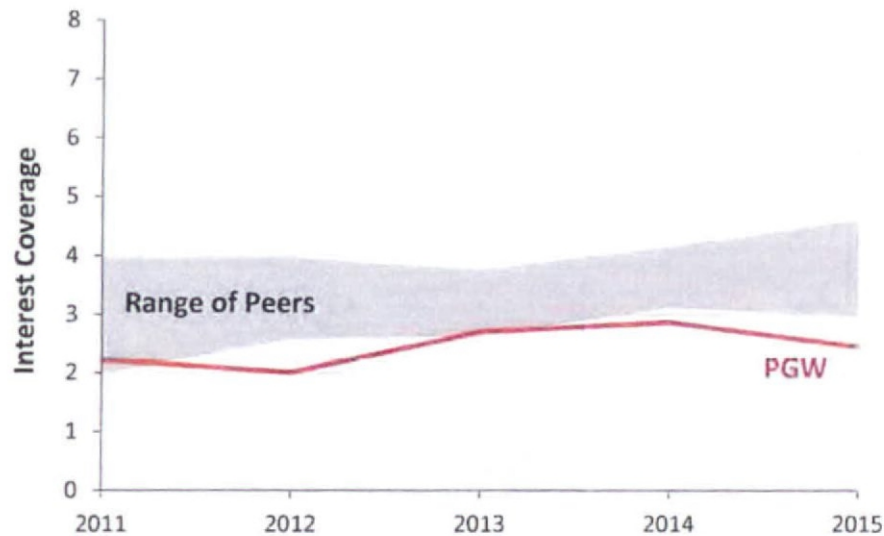
PGW: Comprehensive Annual Financial Report 2011, 2012, 2013, 2014, 2015; Brattle analysis of SNL data for Citizens; Brattle analysis of annual financial reports for Richmond, Colorado Springs, CPS, SMUD, JEA, and Seattle City.

Peer Average denotes average of each column, excluding PGW.

Q37. DID PGW'S INTEREST-ONLY DEBT SERVICE COVERAGE IMPROVE OVER TIME?

A37. PGW's Interest-Only Debt Service Coverage, which obviously must always be above 1.0 to make payments, fluctuated between 2.0 and 3.0 over the 2011-2015 time horizon, and these levels were an improvement from levels prior to the 2009/10 rate case where the Interest-Only Debt Service Coverage ratio had a value of 1.6 in 2008. But even with the improvement, PGW's metric level remained below or at the low range of Munis peers from 2011-2015. As shown in FCG Figure – 25, the range of Interest-Only Debt Service Coverage ratios for municipals improved on the low end from about 2 to 3 and increased on the high end from about 4 to 4.5. Over the same time period, PGW's ratio fluctuated without an overall upward trend.

FCG Figure – 25
Muni Interest-Only Debt Service Coverage Band



Sources: PGW Comprehensive Annual Financial Report 2011, 2012, 2013, 2014, 2015;
Brattle analysis of SNL data for Citizens; Brattle analysis of annual financial reports for
Richmond, Colorado Springs, CPS, SMUD, JEA, Seattle City.

Q38. THE RATIOS DISCUSSED SO FAR HAVE BEEN ENTIRELY ON THE FINANCIAL HEALTH OF PGW AND ITS PEERS. HOW DOES THIS INFORMATION RELATE TO IMPROVEMENTS IN THE PHYSICAL INFRASTRUCTURE OF A UTILITY?

A38. When planning infrastructure improvements, such as replacing cast iron pipe, utilities balance the physical health of the system (e.g., age, material condition, capabilities, etc.) against the financial health of the utility. When a municipal utility increases its investment in infrastructure upgrades, the CapEx will impact the utility through a combination of increased debt financing, decreased customer equity, and decreased liquidity. If the utility has tenuous financial health on an absolute basis prior to the investment, this increased strain may diminish financial metrics and result in a credit rating downgrade and other adverse impacts related to the utility's ability to issue debt at low costs. Conversely, if a utility tries to protect its financial health by cutting back on maintenance or reducing capital improvements in the system, the riskiness of the utility will increase as potential liabilities related to unanticipated capital expenditures, costs related to service degradation, later increases in operational and maintenance costs, and other liabilities related to aging infrastructure that may also increase. Thus,

1 even with the dedicated DSIC funding for some iron main replacement, there are
2 ongoing, competing needs for funding that require overall financial strength.

3 **Q39. IS PGW KEEPING PACE WITH ITS PEERS ON REINVESTMENT INTO THE**
4 **GAS SYSTEM?**

5 A39. With the Commission's approval of PGW's Long Term Infrastructure Improvement
6 Plan and DSIC surcharge, PGW has been able to increase its capital expenditures
7 program as discussed in Mr. Moser's testimony. However, based on my analysis, PGW
8 is investing into its infrastructure at a slower pace than peers. These results carry the
9 caveat that the DSIC funding is not fully reflected in the benchmarking analysis as a
10 result of the time period considered and that PGW may have been limited in its ability
11 to invest due to overall financial performance. I considered three different metrics that
12 inform the similarities and differences between the peer companies, via relationships
13 between capital expenditures, depreciation, and revenues. Specifically, I considered the
14 ratios of Net Plant to Gross Plant ("Net Plant/Gross Plant"), CapEx to Net Plant
15 ("CapEx/Net Plant") and CapEx to Depreciation and Amortization ("CapEx/DA").
16 which are defined below in FCG Figure – 26. Each of these ratios describes one aspect
17 of reinvestment into the system. For example, the ratio of net plant to gross plant
18 describes the age of the system on a financial basis. If the net plant divided by gross
19 plant is high, the values are relatively similar and few assets have been depreciated; the
20 lower the number, the older and more depreciated the assets are, everything else being
21 equal. (This can also be low if a utility is not capitalizing assets to the same extent as
22 its peers.)

23 **FCG Figure – 26**
24 **Financial Definitions for Efficiency/Turnover**

25	Left Column/Heading	Right Column
	Net Plant/Gross Plant	Net Plant / Gross Plant
	CapEx/Net Plant	CapEx / Net Plant
	CapEx/DA	CapEx / (Depreciation + Amortization)

26 On most of these metrics, PGW was lower than average across 2011-2015 compared to
27 PA IOU peers, and it was the lowest on all of them amongst the AU IOU peers, as

shown in FCG Figure – 27. This indicates to me that PGW is replacing its older main at a slower pace than its peers. As I discussed previously, a lower Net Plant/Gross Plant metric generally indicates an older age of a system, and by this metric, PGW had the oldest system in the PA IOU and AU IOU peer groups. PGW also had the lowest CapEx/Net Plant metric for the IOU peer groups, indicating that on a percentage basis, it was reinvesting at a slower rate relative to the size of its system. Finally, PGW had the lowest CapEx/DA ratio of both the PA and AU IOU peers, which indicates that relative to its peers, it was depreciating its system faster than it was reinvesting.

FCG Figure – 27
Efficiency/Turnover Metrics for IOU Peer Groups Average 2011-2015

	CapEx / DA	Net Plant / Gross Plant	CapEx / Net Plant
PA IOUs			
PGW	1.68	0.57	0.06
Central Penn	2.26	0.68	0.08
Columbia	4.86	0.77	0.16
National Fuel Gas	1.92	0.63	0.07
PECO	2.43	0.69	0.08
Penn Natural Gas	2.59	0.71	0.07
Peoples	3.14	0.68	0.06
Peoples TWP	2.27	0.66	0.09
Peer Average	2.78	0.69	0.09
AU IOUs			
PGW	1.68	0.57	0.06
BGE	2.33	0.64	0.11
Boston Gas	2.28	0.62	0.13
BUG Co	3.17	0.67	0.11
ConEd	2.58	0.78	0.09
PSEG	4.52	0.72	0.16
Peer Average	2.98	0.69	0.12

Sources and Notes:

PGW Comprehensive Annual Financial Report 2011, 2012, 2013, 2014, 2015;

Brattle analysis of SNL data.

Peer Average denotes average of each column, excluding PGW.

As I discussed previously, the extent of a utility to invest in its infrastructure is quite sensitive to its financial metrics, so despite its goals of system improvement, PGW's relative speed of investment may have been tempered by the need to maintain its

1 financial health. For example, additional debt financing for greater reinvestment would
2 have decreased coverage ratios, and increased the leverage of its capital structure.
3 Likewise, using a greater percentage of internally generated funds for CapEx would
4 have removed those funds for other liquidity needs and exposed PGW to greater risks
5 from revenue variances. With maintained or improved financial health going forward,
6 PGW will be in a position to continue or accelerate its replacement of cast iron and
7 unprotected steel pipes.

8 **Q40. PLEASE SUMMARIZE YOUR OVERALL IMPRESSIONS OF PGW'S**
9 **ABSOLUTE AND RELATIVE FINANCIAL HEALTH, BASED ON THE**
10 **BENCHMARKING YOU HAVE DESCRIBED.**

11 A40. It is clear that PGW is considerably healthier today than it was in 2009, as noted by
12 improvements in its bond ratings and in the majority of the benchmarking metrics I
13 have evaluated. However, both the IOU peers and the muni peers have also improved
14 in the last few years, and in the case of the munis, they have often improved as much or
15 more than PGW – and PGW started towards the bottom of the ranges in 2009 with
16 metrics that were fragile. Thus even with improvements, it still is less attractive than
17 some of its peers, and it has only a modest cushion for adverse variances that could
18 occur. This is particularly notable in Days Cash and bond coverage, which I
19 understand are key metrics of concern to ratings agencies.

20 **IV. PROJECTED METRICS WITH AND WITHOUT PROPOSED RATE**
21 **INCREASE**

22 **Q41. HOW WOULD THE PROPOSED RATE INCREASE IMPACT PGW'S**
23 **BENCHMARKED RATIOS?**

24 A41. The proposed rate increase would allow PGW to maintain liquidity levels in the FPFTY
25 and recover a more balanced capital structure in the longer term. I drew these
26 conclusions by considering the evolution of PGW's financial health across four time
27 periods: the Historical Test Year ("HTY," September 1, 2015 – August 31, 2016), the
28 Future Test Year ("FTY," September 1, 2016 – August 31, 2017), the FPFTY
29 (September 1, 2017 – August 31, 2018), and the Forecast Period (September 1, 2019 –

August 31, 2022.) As shown in FCG Figure – 28, I considered the Debt/Capitalization, Days Cash, and Debt Service Coverage (Principal & Interest) metrics in each period, as well as these metrics in the FTFY and Forecast Period with and without the proposed \$70 million rate increase.

Even without any financial shocks, PGW is facing significant changes to its balance and cash balances. PGW will show a FTY (FY 2016-17) year-end decrease of approximately \$260 million in equity, which I understand is largely to satisfy its OPEB funding requirements. This decrease in equity will substantially affect PGW's debt to capitalization structure, taking it from 78% to 97% at the end of the FTY, as shown in FCG Figure – 28. Without a rate increase, PGW will remain highly levered from the FTY through the end of the Forecast Period with 88% Debt/Capitalization at the end of August 2022. With a \$70 million rate increase, the Debt/Capitalization ratio in the FPFTY would be 91% (compared to 96% without) and down to 69% by the end of August 2022.

FCG Figure – 28
Historical and Projected Metrics for PGW

Metric	Rate Increase (\$MM)	HTY	FTY	FPFTY	Forecast Period			
		2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
Debt/Capitalization	0	78%	97%	96%	94%	94%	91%	88%
	70	78%	97%	91%	84%	81%	75%	69%
Days Cash	0	62	75	34	-8	-67	-118	-178
	70	62	75	82	88	74	74	58
Debt Service Coverage (Principal & Interest)	0	1.6	1.4	1.2	1.4	1.3	1.4	1.4
	70	1.6	1.4	1.9	2.1	2.0	2.1	2.1

Sources and Notes:

PGW-provided pro forma financial statements.

Projected metrics comparable to historical metrics; both calculated using definitions outlined in FCG Figure A –

1. Fully projected future test year is boxed. The FTY relies on a 30 year normal; all subsequent time periods including the FPFTY use 10 year weather normals. Due to differences in calculation, the Debt Service Coverage (Principal & Interest) metric understates PGW's covenanted debt service coverage calculation. This year-end Days Cash metric varies from the corresponding amounts presented in Mr. Golden's testimony due to a variation in metric calculation. The Days Cash used in Mr. Golden's testimony removes amortized pension expenses from operating expenses. I do not exclude this amortized amount from the Days Cash metric because it is not feasible to make that some adjustment on all the benchmarking peers.

In addition to impacts on equity, the OPEB requirements will significantly impact PGW's liquidity in the Forecast Period. As shown in FCG Figure – 28, without a rate increase, PGW is projected to have 34 Days Cash at the end of the FPFTY (2017/18);

1 this approximately half of the average Days Cash over the 2011-2015 time period.³¹ At
2 the end of FY 2019, PGW would have negative Days Cash, indicating a strong need (if
3 feasible) to issue more debt (on top of the 96% Debt/Capitalization or to obtain
4 immediate rate relief). If PGW is granted a \$70 million rate increase, PGW would have
5 cash to cover 82 days of operating expenses in at the end of the FTFPY (2017/18).

6 The Interest-Only Debt Service Coverage ratio is superficially unaffected without a rate
7 increase; however, this is due to accounting practice than a sign of solvency. In its
8 accounting, PGW treated the OPEB changes as a balance sheet only transaction – that
9 is, it did not occur as a cost on the income statement. Because it does not show as a
10 cost on the income statement, the total funds available to cover debt service coverage
11 are not affected.

12 V. CONCLUSIONS

13 Q42. PLEASE SUMMARIZE YOUR ANALYSIS AND RESULTS.

14 A42. My analysis demonstrates that PGW's financial performance improved following the
15 2009/10 rate case and stabilized over the 2011-2015 time period at performance levels
16 lagging peers. Compared to average performance of its peers over the 2011-2015 time
17 period, PGW was more levered; less liquid on a Days Cash basis; and less solvent on
18 multiple coverage ratios. These performance metrics are reflected in PGW's credit
19 ratings that improved 1-3 levels following the 2009/10 rate case but remain 1-2 levels
20 below IOU peers and 4-6 levels between municipal peers. If PGW were to continue to
21 earn revenues at current rates going forward, liquidity and equity metrics would be
22 lower than pre-2009/10 levels as a result of OPEB liabilities. With the requested rate
23 increase, PGW would maintain its liquidity levels and recover a more balanced capital
24 structure more quickly.

³¹ Note that this year-end Days Cash metric varies from the figure presented in Mr. Golden's testimony due to a variation in metric calculation. The days cash metric used in Mr. Golden's testimony removes amortization of pension expenses from operating expenses; I do not exclude this amortized amount from the Days Cash metric calculation.

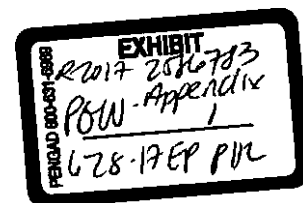
1 It is also important to appreciate that if PGW receives the requested rate relief and
2 enjoys low stress operating conditions over the next few years, the benefit of having
3 improved its financial health will not be lost to customers. That is, unlike an IOU, the
4 gains from profitability that the company may enjoy will redound back to the customers
5 of a municipal utility in one of several forms: It may be able to internally fund (and
6 possibly accelerate) improvements to its system, thereby avoiding future debt issuance
7 and the associated interest expenses. It may gain a better debt rating that reduces the
8 interest cost of new debt, of which a fair amount (approximately \$270 million) is
9 required by PGW over the next few years. And it may be able to avoid or reduce a
10 future rate increase. In short, the funds that will secure PGW's financial health are
11 ultimately repaid to ratepayers, unlike the situation in an IOU where the gains from
12 extra revenue are generally split between ratepayers and third-party equity investors.

13 **Q43. DOES THIS CONCLUDE YOUR DIRECT TESTIMONY?**

14 A43. Yes, it does.

APPENDIX 1: RESUME OF FRANK C. GRAVES

(This page intentionally left blank. Resume begins on following page.)



FRANK C. GRAVES

Principal

Cambridge MA

+1.617.864.7900

Frank.Graves@brattle.com

Mr. Frank C. Graves is a Principal of The Brattle Group and the leader of its Utility Practice Area line of business. He specializes in regulatory and financial economics, especially for electric and gas utilities, and in litigation matters related to securities litigation, damages from breached energy contracts, and risk management.

He has over 30 years of experience assisting utilities in forecasting, valuation, and risk analysis of many kinds of long range planning and service design decisions, such as generation and network capacity expansion, fuel and gas supply procurement, pricing and cost recovery mechanisms, cost and performance benchmarking, network flow modeling, renewable asset selection and contracting, and hedging strategies. He has testified before many state regulatory commissions and the FERC as well as in state and federal courts and arbitration proceedings on such matters as integrated resource planning (IRPs), energy contract disputes, the prudence of investment and contracting decisions, risk management, costs and benefits of new services, policy options for industry restructuring, adequacy of market competition, and competitive implications of proposed mergers and acquisitions.

In the area of financial economics, he has assisted and testified in civil cases in regard to contract damages estimation, securities litigation suits, special purpose audits, tax disputes, risk management, and cost of capital estimation, and he has testified in criminal cases regarding corporate executives' culpability for securities fraud.

He received an M.S. with a concentration in finance from the M.I.T. Sloan School of Management in 1980, and a B.A. in Mathematics from Indiana University in 1975.

AREAS OF EXPERTISE

- Utility Planning and Operations
- Regulated Industry Policy and Restructuring
- Energy Market Competition
- Electric and Gas Transmission
- Financial Analysis and Commercial Litigation

PROFESSIONAL AFFILIATIONS

- IEEE Power Engineering Society
- Mathematical Association of America
- American Finance Association

REPRESENTATIVE ENGAGEMENTS

Utility Planning and Operations

- Mr. Graves developed a valuation and risk analysis model showing that a utility's RFP for new generation could be better served by deferring new plant construction for a few years via a less costly and less risky transitional market-based power supply contract with price and quantity terms shaped to match the shifting needs over time until supply shortfalls were large enough to justify the investment in a new power plant at efficient scale. The parties negotiated a multi-year contract along these lines in lieu of pursuing the construction alternative that initially came out of the RFP selection.
- In Maryland the electric distribution companies administer SOS (Standard Offer Service) supply procurement and accounting to backup customers who do not use a competitive retail power supplier. The utilities are authorized to recover both the direct and financing costs of that service plus a return on equity. Mr. Graves developed a method for sizing an appropriate equity return for the SOS risks and administrative services based on analogies to various intermediation businesses on the internet, such as EBay, PayPal, and others—in which, like SOS intermediation, the businesses do not take ownership for the products conveyed. Testimony was provided.
- Mr. Graves co-lead a team of Brattle analysts to assess the relative influence of different factors that were affected by the “Polar Vortex” cold snap of early 2014 that caused dramatic spikes in local power and gas prices in parts of the mid-Atlantic and northeastern US. The risks of similar recurring events were assessed in light of pending expansions of the electric and gas transmission grids, as well as likely coal plant retirements.
- For the Board of Directors or executive management teams of several utilities, Mr. Graves has lead strategic retreats on disruptive issues facing the electric industry in the future and how a utility should choose which risks and opportunities to embrace vs. avoid.
- Air quality and other power plant environmental regulations are being tightened considerably in the period from about 2014-2018. Mr. Graves has co-developed a market and financial model for determining what power plants are most likely to retire vs. retrofit with new environmental controls, and how much this may alter their profitability. This has been used to help several power market participants assess future capacity needs, as well as to adjust their price forecasts for the coming decade.
- Successful merchant power plant development and financing depends in part on obtaining a long term power purchase agreement. Mr. Graves directed a study of what pricing points and risk-sharing terms should be attractive to potential buyers of long-term power supply contracts from a large baseload facility.

- Many utilities are pursuing smart meters and time-of-use pricing to increase customer ability to consume electricity economically. Mr. Graves has led a study of the costs and benefits of different scales and timing of installation of such meters, to determine the appropriate pace. He has also evaluated how various customer incentives to increase conservation and demand response might be provided over the internet, and how much they might increase the participation rates in smart meter programs.
- Wind resources are a critical part of the generation expansion plans and contracting interests of many utilities, in order to satisfy renewable portfolio standards and to reduce long run exposure to carbon prices and fuel cost uncertainty. Mr. Graves has applied Brattle's risk modeling capabilities to simulate the impacts of on- and off-shore wind resources on the potential range of costs for portfolios of wholesale power contracts designed to serve retail electricity loads. These impacts were compared to gas CCs and CTs and to simply buying more from the wholesale market to identify the most economical supply strategy.
- For a municipal utility with an opportunity to invest in a nuclear power plant expansion, Mr. Graves lead an analysis of how the proposed plant fit the needs of the company, what market and regulatory (environmental) conditions would be required for the plant to be more economical than conventional fossil-fired generation, and how the development risks could be shared among co-owners to better match their needs and risk tolerances. He also assessed the market for potential off-take contracts to recover some of the costs and capacity that would be available for a few years, ahead of the needs of the municipal utility.
- The potential introduction of environmental restrictions or fees for CO2 emissions has made generation expansion decisions much more complex and risky. He helped one utility assess these risks in regard to a planned baseload coal plant, finding that the value of flexibility in other technologies was high enough to prefer not building a conventional coal plant.
- Mr. Graves helped design, implement, and gain regulatory approvals for a natural gas procurement hedging program for a western U.S. gas and electric utility. A model of how gas forward prices evolve over time was estimated and combined with a statistical model of the term structure of gas volatility to simulate the uncertainty in the annual cost of gas at various times during its procurement, and the resulting impact on the range of potential customer costs.
- Generation planning for utilities has become very complex and risky due to high natural gas prices and potential CO2 restrictions of emission allowances. Some of the scenarios that must be considered would radically alter system operations relative to current patterns of use. Mr. Graves has assisted utilities with long range planning for how to measure and cope with these risks, including how to build and value contingency plans in their resource selection criteria, and what

kinds of regulatory communications to pursue to manage expectations in this difficult environment.

- For a Midwestern utility proposing to divest a nuclear plant, Mr. Graves analyzed the reasonableness of the proposed power buyback agreement and the effects on risks to utility customers from continued ownership vs. divestiture. The decommissioning funds were also assessed as to whether their transfer altered the appropriate purchase price.
- Several utilities with coal-fired power plants have faced allegations from the U.S. EPA that they have conducted past maintenance on these plants which should be deemed "major modifications", thereby triggering New Source Review standards for air quality controls. Mr. Graves has helped one such utility assess limitations on the way in which GADS data can be used retrospectively to quantify comparisons between past actual and projected future emissions. For another utility, Mr. Graves developed retrospective estimates of changes in emissions before and after repairs using production costing simulations. In a third, he reviewed contemporaneous corporate planning documents to show that no increase in emissions would have been expected from the repairs, due to projected reductions in future use of the plant as well as higher efficiency. In all three cases, testimony was presented.
- The U.S. Government is contractually obligated to dispose of spent nuclear fuel at commercial reactors after January 1998, but it has not fulfilled this duty. As a result, nuclear facilities that are shutdown or facing full spent fuel pools are facing burdensome costs and risks. Mr. Graves prepared developed an economic model of the performance that could have reasonably been expected of the government, had it not breached its contract to remove the spent fuel.
- Capturing the full value of hydroelectric generation assets in a competitive power market is heavily dependent on operating practices that astutely shift between real power and ancillary services markets, while still observing a host of non-electric hydrological constraints. Mr. Graves led studies for several major hydro generation owners in regard to forecasting of market conditions and corresponding hydro schedule optimization. He has also designed transfer pricing procedures that create an internal market for diverting hydro assets from real power to system support services firms that do not yet have explicit, observable market prices.
- Mr. Graves led a gas distribution company in the development of an incentive ratemaking system to replace all aspects of its traditional cost of service regulation. The base rates (for non-fuel operating and capital costs) were indexed on a price-cap basis (RPI-X), while the gas and upstream transportation costs allowances were tied to optimal average annual usage of a reference portfolio of supply and transportation contracts. The gas program also included numerous adjustments to the gas company's rate design, such as designing new standby rates so that customer choice will not be distorted by pricing inefficiencies.

- An electric utility with several out-of-market independent power contracts wanted to determine the value of making those plants dispatchable and to devise a negotiating strategy for restructuring the IPP agreements. Mr. Graves developed a range of forecasts for the delivered price of natural gas to this area of the country. Alternative ways of sharing the potential dispatch savings were proposed as incentives for the IPPs to renegotiate their utility contracts.
- For an electric utility considering the conversion of some large oil-fired units to natural gas, Mr. Graves conducted a study of the advantages of alternative means of obtaining gas supplies and gas transportation services. A combination of monthly and daily spot gas supplies, interruptible pipeline transportation over several routes, gas storage services, and "swing" (contingent) supply contracts with gas marketers was shown to be attractive. Testimony was presented on why the additional services of a local distribution company would be unneeded and uneconomic.
- A power engineering firm entered into a contract to provide operations and maintenance services for a cogenerator, with incentives fees tied to the unit's availability and operating cost. When the fees increased due to changes in the electric utility tariff to which they were tied, a dispute arose. Mr. Graves provided analysis and testimony on the avoided costs associated with improved cogeneration performance under a variety of economic scenarios and under several alternative utility tariffs.
- Mr. Graves has helped several pipelines design incentive pricing mechanisms for recovering their expected costs and reducing their regulatory burdens. Among these have been Automatic Rate Adjustment Mechanisms (ARAMs) for indexation of operations and maintenance expenses, construction-cost variance-sharing for routine capital expenditures that included a procedure for eliciting unbiased estimates of future costs, and market-based prices capped at replacement costs when near-term future expansion was an uncertain but probable need.
- For a major industrial gas user, he prepared a critique of the transportation balancing charges proposed by the local gas distribution company. Those charges were shown to be arbitrarily sensitive to the measurement period as well as to inconsistent attribution of storage versus replacement supply costs to imbalance volumes. Alternative balancing valuation and accounting methods were shown to be cheaper, more efficient, and simpler to administer. This analysis helped the parties reach a settlement based on a cash-in/cash-out design.
- The Clean Air Act Amendments authorized electric utilities to trade emission allowances (EAs) as part of their approach to complying with SO₂ emissions reductions targets. For the Electric Power Research Institute (EPRI), Mr. Graves developed multi-stage planning models to illustrate how the considerable uncertainty surrounding future EA prices justifies waiting to invest in irreversible control technologies, such as scrubbers or SCRs, until the present value cost of such investments is significantly below that projected from relying on EAs.

- For an electric utility with a troubled nuclear plant, Mr. Graves presented testimony on the economic benefits likely to ensue from a major reorganization. The plant was to be spun off to a jointly-owned subsidiary that would sell available energy back to the original owner under a contract indexed to industry unit cost experience. This proposal afforded a considerable reduction of risk to ratepayers in exchange for a reasonable, but highly uncertain prospect of profits for new investors. Testimony compared the incentive benefits and potential conflicts under this arrangement to the outcomes foreseeable from more conventional incentive ratemaking arrangements.
- Mr. Graves helped design Gas Inventory Charge (GIC) tariffs for interstate pipelines seeking to reduce their risks of not recovering the full costs of multi-year gas supply contracts. The costs of holding supplies in anticipation of future, uncertain demand were evaluated with models of the pipeline's supply portfolio that reveal how many non-production costs (demand charges, take-or-pay penalties, reservation fees, or remarketing costs for released gas) would accrue under a range of demand scenarios. The expected present value of these costs provided a basis for the GIC tariff.
- Mr. Graves performed a review and critique of a state energy commission's assessment of regional natural gas and electric power markets in order to determine what kinds of pipeline expansion into the area was economic. A proposed facility under review for regulatory approval was found to depend strongly on uneconomic bypass of existing pipelines and LDCs. In testimony, modular expansion of existing pipelines was shown to have significantly lower costs and risks.
- For several electric utilities with generation capacity in excess of target reserve margins, Mr. Graves designed and supervised market analyses to identify resale opportunities by comparing the marginal operating costs of all this company's power plants not needed to meet target reserves to the marginal costs for almost 100 neighboring utilities. These cost curves were then overlaid on the corresponding curve for the client utility to identify which neighbors were competitors and which were potential customers. The strength of their relative threat or attractiveness could be quantified by the present value of the product of the amount, duration, and differential cost of capacity that was displaceable by the client utility.
- Mr. Graves specified algorithms for the enhancement of the EPRI EGEAS generation expansion optimization model, to capture the first-order effects of financial and regulatory constraints on the preferred generation mix.
- For a major electric power wholesaler, Mr. Graves developed a framework for estimating how pricing policies affect the relative attractiveness of capacity expansion alternatives. Traditional cost-recovery pricing rules can significantly distort the choice between two otherwise equivalent capacity plans, if one includes a severe "front end load" while the other does not. Price-demand

feedback loops in simulation models and quantification of consumer satisfaction measures were used to appraise the problem. This "value of service" framework was generalized for the Electric Power Research Institute.

- For a large gas and electric utility, Mr. Graves participated in coordinating and evaluating the design of a strategic and operational planning system. This included computer models of all aspects of utility operations, from demand forecasting through generation planning to financing and rate design. Efforts were split between technical contributions to model design and attention to organizational priorities and behavioral norms with which the system had to be compatible.
- For an oil and gas exploration and production firm, Mr. Graves developed a framework for identifying what industry groups were most likely to be interested in natural gas supply contracts featuring atypical risk-sharing provisions. These provisions, such as price indexing or performance requirements contingent on market conditions, are a form of product differentiation for the producer, allowing it to obtain a price premium for the insurance-like services.
- For a natural gas distribution company, Mr. Graves established procedures for redefining customer classes and for repricing gas services according to customers' similarities in load shape, access to alternative gas supplies, expected growth, and need for reliability. In this manner, natural gas service was effectively differentiated into several products, each with price and risk appropriate to a specific market. Planning tools were developed for balancing gas portfolios to customer group demands.
- For a Midwestern electric utility, Mr. Graves extended a regulatory pro forma financial model to capture the contractual and tax implications of canceling and writing off a nuclear power plant in mid-construction. This possibility was then appraised relative to completion or substitution alternatives from the viewpoints of shareholders (market value of common equity) and ratepayers (present value of revenue requirements).
- For a corporate venture capital group, Mr. Graves conducted a market-risk assessment of investing in a gas exploration and production company with contracts to an interstate pipeline. The pipeline's market growth, competitive strength, alternative suppliers, and regulatory exposure were appraised to determine whether its future would support the purchase volumes needed to make the venture attractive.
- For a natural gas production and distribution company, he developed a strategic plan to integrate the company's functional policies and to reposition its operations for the next five years. Decision analysis concepts were combined with marginal cost estimation and financial pro forma simulation to identify attractive and resilient alternatives. Recommendations included target markets, supply sources, capital budget constraints, rate design, and a planning system. A two-day

planning conference was conducted with the client's executives to refine and internalize the strategy.

- For the New Mexico Public Service Commission, he analyzed the merits of a corporate reorganization of the major New Mexico gas production and distribution company. State ownership of the company as a large public utility was considered but rejected on concerns over efficiency and the burdening of performance risks onto state and local taxpayers.

Regulated Industry Policy and Restructuring

- For a group of utilities responding to a state mandate to consider means of encouraging distributed technologies to be assessed and incentivized in parity with central station generation, Mr. Graves and others at Brattle prepared alternative means of incorporating marginal cost and externality value considerations into new cost/benefit assessment tools, procurement mechanisms, and supply contracting.
- For a mid-Atlantic gas distribution utility, Mr. Graves assessed mark to market losses that had occurred from gas supply hedges entered before spot prices declined precipitously. Concerns were voiced that this outcome indicated the company's hedging practices were no longer attune to market conditions, so Mr. Graves developed and lead workshop between the company, intervener groups, and state commission staff to define new appropriate goals, mechanisms and review standards for revised risk management approach.
- For a major participant in the Japanese power industry contemplating reorganization of that country's electric sector following Fukushima, Mr. Graves lead a research project on the performance of alternative market designs around the US and around the world for vertical unbundling, RTO design, and retail choice.
- For several utilities facing the end of transitional "provider of last resort" (or POLR) prices, Mr. Graves developed forecasts and risk analyses of alternative procurement mechanisms for follow-on POLR contracts. He compared portfolio risk management approaches to full requirements outsourcing under various terms and conditions.
- For a large municipal electric and gas company considering whether to opt-in to state retail access programs, Mr. Graves lead an analysis of what changes in the level and volatility of customer rates would likely occur, what transition mechanisms would be required, and what impacts this would have on city revenues earned as a portion of local electric and gas service charges.
- Many utilities experienced significant "rate shock" when they ended "rate freeze" transition periods that had been implemented with earlier retail restructuring. The adverse customer and political reactions have led to proposals to annual procurement auctions and to return to utility-owned or managed supply

portfolios. Mr. Graves has assisted utilities and wholesale gencos with analyses of whether alternative supply procurement arrangements could be beneficial.

- The impacts of transmission open access and wholesale competition on electric generators risks and financial health are well documented. In addition, there are substantial impacts on fuel suppliers, due to revised dispatch, repowerings and retirements, changes in expansion mix, altered load shapes and load growth under more competitive pricing. For EPRI, Mr. Graves co-authored a study that projected changes in fuel use within and between ten large power market regions spanning the country under different scenarios for the pace and success of restructuring.
- As a result of vertical unbundling, many utilities must procure a substantial portion of their power from resources they do not own or operate. Market prices for such supplies are quite volatile. In addition, utilities may face future customer switching to or from their supply service, especially if they are acting as provider of last resort (POLR). This problem is a blending of risk management with the traditional least-cost Integrated Resource Planning (IRP). Regulatory standards for findings of prudence in such a hybrid environment are often not well understood or articulated, leaving utilities at risk for cost disallowances that can jeopardize their credit-worthiness. Mr. Graves has assisted several utilities in devising updated procurement mechanisms, hedging strategies, and associated regulatory guidelines that clarify the conditions for approval and cost recovery of resource plans, in order to make possible the expedited procurement of power from wholesale market suppliers.
- Public power authorities and cooperatives face risks from wholesale restructuring if their sales-for-resale customers are free to switch to or from supply contracting with other wholesale suppliers. Such switching can create difficulties in servicing the significant debt capitalization of these public power entities, as well as equitable problems with respect to non-switching customers. Mr. Graves has lead analyses of this problem, and has designed alternative product pricing, switching terms and conditions, and debt capitalization policies to cope with the risks.
- As a means of unbundling to retain ownership but not control of generation, some utilities turned to divesting output contracts. Mr. Graves was involved in the design and approval of such agreements for a utility's fleet of generation. The work entailed estimating and projecting cost functions that were likely to track the future marginal and total costs of the units and analysis of the financial risks the plant operator would bear from the output pricing formula. Testimony on risks under this form of restructuring was presented.
- Mr. Graves contributed to the design and pricing of unbundled services on several natural gas pipelines. To identify attractive alternatives, the marginal costs of possible changes in a pipeline's service mix were quantified by simulating the least-cost operating practices subject to the network's physical and contractual constraints. Such analysis helped one pipeline to justify a zone-based rate design

for its firm transportation service. Another pipeline used this technique to demonstrate that unintended degradations of system performance and increased costs could ensue from certain proposed unbundlings that were insensitive to system operations.

- For several natural gas pipeline companies, Mr. Graves evaluated the cost of equity capital in light of the requirements of FERC Order 636 to unbundle and reprice pipeline services. In addition to traditional DCF and risk positioning studies, the risk implications of different degrees of financial leverage (debt capitalization) were modeled and quantified. Aspects of rate design and cost allocation between services that also affect pipeline risk were considered.
- Mr. Graves assisted several utilities in forecasting market prices, revenues, and risks for generation assets being shifted from regulated cost recovery to competitive, deregulated wholesale power markets. Such studies have facilitated planning decisions, such as whether to divest generation or retain it, and they have been used as the basis for quantifying stranded costs associated with restructuring in regulatory hearings. Mr. Graves has assisted a leasing company with analyses of the tax-legitimacy of complex leasing transactions by reviewing the extent and quality of due diligence pursued by the lessor, the adequacy of pre-tax returns, the character, time pattern, and degree of risk borne by the buyer (lessor), the extent of defeasance, and compliance with prevailing guidelines for true-lease status.

Market Competition

- Mr. Graves assisted a nuclear plant owner with an assessment of whether a proposed merger of a company in whom it had a partial investment interest would alter the co-owner's incentives to manage the plant for maximum stand-alone value of the asset. Structural and behavioral models of the relevant market were developed to determine that there would be no material changes in incentive or ability to affect the value of the asset.
- Mr. Graves has testified on the quality of retail competition in Pennsylvania and on whether various proposals for altering Default Service might create more robust competition.
- Regulatory and legal approvals of utility mergers require evidence that the combined entity will not have undue market power. Mr. Graves assisted several utilities in evaluating the competitive impacts of potential mergers and acquisitions. He has identified ways in which transmission constraints reduce the number and type of suppliers, along with mechanisms for incorporating physical flow limits in FERC's Delivered Price Test (DPT) for mergers. He has also assessed the adequacy of mitigation measures (divestitures and conduct restrictions) under the DPT, Market-Based Rates, and other tests of potential market power arising from proposed mergers.

- A major concern associated with electric utility industry restructuring is whether or not generation markets are adequately competitive. Because of the state-dependent nature of transmission transfer capability between regions, itself a function of generation use, the quality of competition in the wholesale generation markets can vary significantly and may be susceptible to market power abuse by dominant suppliers. Mr. Graves helped one of the largest ISOs in the U.S. develop market monitoring procedures to detect and discourage market manipulations that would impair competition.
- Vertical market power arises when sufficient control of an upstream market creates a competitive advantage in a downstream market. It is possible for this problem to arise in power supply, in settings where the likely marginal generation is dependent on very few fuel suppliers who also have economic interests in the local generation market. Mr. Graves analyzed this problem in the context of the California gas and electric markets and filed testimony to explain the magnitude and manifestations of the problem.
- The increased use of transmission congestion pricing has created interest in merchant transmission facilities. Mr. Graves assisted a developer with testimony on the potential impacts of a proposed line on market competition for transmission services and adjacent generation markets. He also assisted in the design of the process for soliciting and ranking bids to buy tranches of capacity over the line.
- Many regions have misgivings about whether the preconditions for retail electric access are truly in place. In one such region, Mr. Graves assisted a group of industrial customers with a critique of retail restructuring proposals to demonstrate that the locally weak transmission grid made adequate competition among numerous generation suppliers very implausible.
- Mr. Graves assisted one of the early ISOs with its initial market performance assessment and its design of market monitoring tests for diagnosing the quality of prevailing competition.

Electric and Gas Transmission

- Substantial fleets of wind-based generation can impose significant integration costs on power systems. Mr. Graves assisted in assessing what additional amounts and costs for ancillary services would be needed for a Western utility with a large renewable fleet. The approach included a statistical analysis of how wind output was correlated with demand, and how much forecasting error in wind output was likely to be faced over different scheduling horizons. Benefits of geographic diversity of the wind fleet were also assessed.
- For a utility seeking FERC approval for the purchase of an affiliate's generating facility, Mr. Graves analyzed how transmission constraints affecting alternative supply resources altered their usefulness to the buyer.

- As part of a generation capacity planning study, he lead an analysis of how congestion premiums and discounts relative to locational marginal prices (LMPs) at load centers affected the attractiveness of different potential locations for new generation. At issue was whether the prevailing LMP differences would be stable over time, as new transmission facilities were completed, and whether new plants could exacerbate existing differentials and lead to degraded market value at other plants.
- Mr. Graves assisted a genco with its involvement in the negotiation and settlement of "regional through and out rates" (RTOR) that were to be abolished when MISO joined PJM. His team analyzed the distribution of cost impacts from several competing proposals, and they commented on administrative difficulties or advantages associated with each.
- For the electric utility regulatory commission of Colombia, S.A., Mr. Graves led a study to assess the inadequacies in the physical capabilities and economic incentives to manage voltages at adequate levels. The Brattle team developed minimum reactive power support obligations and supplement reactive power acquisition mechanisms for generators, transmission companies, and distribution companies.
- Mr. Graves conducted a cost-of-service analysis for the pricing of ancillary services provided by the New York Power Authority.
- On behalf of the Electric Power Research Institute (EPRI), Mr. Graves wrote a primer on how to define and measure the cost of electric utility transmission services for better planning, pricing, and regulatory policies. The text covers the basic electrical engineering of power circuits, utility practices to exploit transmission economies of scale, means of assuring system stability, economic dispatch subject to transmission constraints, and the estimation of marginal costs of transmission. The implications for a variety of policy issues are also discussed.
- The natural gas pipeline industry is wedged between competitive gas production and competitive resale of gas delivered to end users. In principle, the resulting basis differentials between locations around the pipeline ought to provide efficient usage and expansion signals, but traditional pricing rules prevent the pipeline companies from participating in the marginal value of their own services. Mr. Graves worked to develop alternative pricing mechanisms and service mixes for pipelines that would provide more dynamically efficient signals and incentives.
- Mr. Graves analyzed the spatial and temporal patterns of marginal costs on gas and electric utility transmission networks using optimization models of production costs and network flows. These results were used by one natural gas transmission company to design receipt-point-based transmission service tariffs, and by another to demonstrate the incremental costs and uneven distribution of impacts on customers that would result from a proposed unbundling of services.

Financial Analysis and Commercial Litigation

- For an international energy company seeking to expand its operations in the US, Mr. Graves lead an assessment of the market performance risks facing a possible acquisition target, in order to determine what contingencies or market shifts were critical to it being an attractive target. Uncertain long run wholesale energy conditions, tightening environmental regulations, and disruptive technology development prospects were considered.
- For an international technology firm that had experienced a recent bankruptcy, Mr. Graves assisted in the design of a study of how the remaining valuable assets could be deemed assignable to disparate country-specific claims. Company operating practices for research and development risk and profit sharing were evaluated to identify an equitable approach.
- For a merchant power company with a prematurely terminated development contract, Mr. Graves co-lead a team to value the lost contract. The contract included several different kinds of revenue streams of different risks, for which Brattle developed different discount rates and debt carrying-capacity assessments. The case was settled with a very large award consistent with the Brattle valuations.
- Holding company utilities with many subsidiaries in different states face differing kinds of regulatory allowances, balancing accounts with differing lags and allowed returns for cost recovery, possibly different capital structures, as well as different (and varying) operating conditions. Given such heterogeneity, it can be difficult to determine which subsidiaries are performing well vs. poorly relative to their regulatory and operational challenges. Mr. Graves developed a set of financial reporting normalization adjustments to isolate how much of each subsidiary's profitability was due to financial, vs. managerial, vs. non-recurring operational conditions, so that meaningful performance appraisal was possible.
- Many banks, insurance firms and capital management subsidiaries of large multinational corporations have entered into long term, cross border leases of properties under sale and leaseback or lease in, lease out terms. These have been deemed to be unacceptable tax shelters by the IRS, but that is an appealable claim. Mr. Graves has assisted several companies in evaluating whether their cross border leases had legitimate business purpose and economic substance, above and beyond their tax benefits, due to likelihood of potentially facing a role as equity holder with ownership risks and rewards. He has shown that this is a case-specific matter, not per se determined by the general character of these transactions.
- For a private energy hedge fund providing risk management contracts to industrial energy users, a breach of contract from one industrial customer was disputed as supposedly involving little or no loss because the fund had not been forced to liquidate positions at a loss that corresponded precisely to the abruptly terminated contract. Mr. Graves provided analysis demonstrating how the portfolio loss was borne, but other fund management metrics used to control

positions, and other unrelated hedging positions, also changed roughly concurrently in a manner that disguised the way the economic damage was realized over time. The case was settled on favorable terms for Mr. Graves' client.

- Many utilities have regulated and unregulated subsidiaries, which face different types and degrees of risk. Mr. Graves lead a study of the appropriate adjustments to corporate hurdle rates for the various lines of business of a utility with many types of operations.
- A company that incurred Windfall Tax liabilities in the U.K. regarded those taxes as creditable against U.S. income taxes, but this was disputed by the IRS. Mr. Graves lead a team that prepared reports and testimony on why the Windfall Tax had the character of a typical excess profits tax, and so should be deemed creditable in the U.S. The tax courts concurred with this opinion and allowed the claimed tax deductions in full.
- For a defendant in a sentencing hearing for securities' fraud, Mr. Graves prepared an analysis of how the defendant's role in the corporate crisis was confounded by other concurrent events and disclosures that made loss calculations unreliable. At trial, the Government stipulated that it agreed with Mr. Graves' analysis.
- For the U.S. Department of Justice, Mr. Graves prepared an event study quantifying bounds on the economic harm to shareholders that had likely ensued from revelations that Dynegy Corporation's "Project Alpha" had been improperly represented as a source of operating income rather than as a financing. The event study was presented in the re-sentencing hearing of Mr. Jamie Olis, the primary architect of Project Alpha.
- Mr. Graves has assisted leasing companies with analyses of the tax-legitimacy of complex leasing transactions. These analyses involved reviewing the extent and quality of due diligence pursued by the lessor, the adequacy of pre-tax returns, the character, time pattern, and degree of risk borne by the buyer (lessor), the extent, purpose and cost of defeasance, and compliance with prevailing guidelines for true-lease status.
- For a utility facing significant financial losses from likely future costs of its Provider of Last Resort (POLR) obligations, Mr. Graves prepared an analysis of how optimal hindsight coverage of the liability would have compared in costs to a proposed restructuring of the obligation. He also reviewed the prudence of prior, actual coverage of the obligation in light of conventional risk management practices and prevailing market conditions of credit constraints and low long-term liquidity.
- Several banks were accused of aiding and abetting Enron's fraudulent schemes and were sued for damages. Mr. Graves analyzed how the stock market had reacted to one bank's equity analyst's reports endorsing Enron as a "buy," to determine if those reports induced statistically significant positive abnormal returns. He showed that individually and collectively they did not have such an effect.

- Mr. Graves lead an analysis of whether a corporate subsidiary had been effectively under the strategic and operational control of its parent, to such an extent that it was appropriate to “pierce the corporate veil” of limited liability. The analysis investigated the presence of untenable debt capitalization in the subsidiary, overlapping management staff, the adherence to normal corporate governance protocols, and other kinds of evidence of excessive parental control.
- As a tax-revenue enhancement measure, the IRS was considering a plan to recapture deferred taxes associated with generation assets that were divested or reorganized during state restructurings for retail access. Mr. Graves prepared a white paper demonstrating the unfairness and adverse consequences of such a plan, which was instrumental in eliminating the proposal.
- For a major electronics and semiconductor firm, Mr. Graves critiqued and refined a proposed procedure for ranking the attractiveness of research and development projects. Aspects of risk peculiar to research projects were emphasized over the standards used for budgeting an already proven commercial venture.
- In a dispute over damages from a prematurely terminated long-term power tolling contract, Mr. Graves presented evidence on why calculating the present value of those damages required the use of two distinct discount rates: one (a low rate) for the revenues lost under the low-risk terminated contract and another, much higher rate, for the valuation of the replacement revenues in the risky, short-term wholesale power markets. The amount of damages was dramatically larger under a two-discount rate calculation, which was the position adopted by the court.
- The energy and telecom industries, especially in the late 1990s and early 2000s, were plagued by allegations regarding trading and accounting misrepresentations, such as wash trades, manipulations of mark-to-market valuations, premature recognition of revenues, and improper use of off-balance sheet entities. In many cases, this conduct has preceded financial collapse and subsequent shareholder suits. Mr. Graves lead research on accounting and financial evidence, including event studies of the stock price movements around the time of the contested practices, and reconstruction of accounting and economic justifications for the way asset values and revenues were recorded.
- Dramatic natural gas price increases in the U.S. have put several natural gas and electric utilities in the position of having to counter claims that they should have hedged more of their fuel supplies at times in the past. Mr. Graves developed testimony to rebut this hindsight criticism and risk management techniques for fuel (and power) procurement for utilities to apply in the future to avoid prudence challenges.
- As a means of calculating its stranded costs, a utility used a partial spin-off of its generation assets to a company that had a minority ownership from public shareholders. A dispute arose as to whether this minority ownership might be depressing the stock price, if a “control premium” was being implicitly deducted from its value. Using event studies and structural analyses, Mr. Graves identified

the key drivers of value for this partially spun-off subsidiary, and he showed that value was not being impaired by the operating, financial and strategic restrictions on the company. He also reviewed the financial economics literature on empirical evidence for control premiums, which he showed reinforced the view that no control premium de-valuation was likely to be affecting the stock.

- A large public power agency was concerned about its debt capacity in light of increasing competitive pressures to allow its resale customers to use alternative suppliers. Mr. Graves lead a team that developed an Economic Balance Sheet representation of the agency's electric assets and liabilities in market value terms, which was analyzed across several scenarios to determine safe levels of debt financing. In addition, new service pricing and upstream supply contracting arrangements were identified to help reduce risks.
- Wholesale generating companies intuitively realize that there are considerable differences in the financial risk of different kinds of power plant projects, depending on fuel type, length and duration of power purchase agreements, and tightness of local markets. However, they often are unaware of how if at all to adjust the hurdle rates applied to valuation and development decisions. Mr. Graves lead a Brattle analysis of risk-adjusted discount rates for generation; very substantial adjustments were found to be necessary.
- A major telecommunications firm was concerned about when and how to reenter the Pacific Rim for wireless ventures following the economic collapse of that region in 1997-99. Mr. Graves lead an engagement to identify prospective local partners with a governance structure that made it unlikely for them to divert capital from the venture if markets went soft. He also helped specify contracting and financing structures that create incentives for the venture to remain together should it face financial distress, while offering strong returns under good performance.
- There are many risks associated with operations in a foreign country, related to the stability of its currency, its macro economy, its foreign investment policies, and even its political system. Mr. Graves has assisted firms facing these new dimensions to assess the risks, identify strategic advantages, and choose an appropriate, risk-adjusted hurdle rate for the market conditions and contracting terms they will face.
- The glut of generation capacity that helped usher in electric industry restructuring in the US led to asset devaluations in many places, even where no retail access was allowed. In some cases, this has led to bankruptcy, especially of a few large rural electric cooperatives. Mr. Graves assisted one such coop with its long term financial modeling and rate design under its plan of reorganization, which was approved. Testimony was provided on cost-of-service justifications for the new generation and transmission prices, as well as on risks to the plan from potential environmental liabilities.

- Power plants often provide a significant contribution to the property tax revenues of the townships where they are located. A common valuation policy for such assets has been that they are worth at least their book value, because that is the foundation for their cost recovery under cost-of-service utility ratemaking. However, restructuring throws away that guarantee, requiring reappraisal of these assets. Traditional valuation methods, e.g., based on the replacement costs of comparable assets, can be misleading because they do not consider market conditions. Mr. Graves testified on such matters on behalf of the owners of a small, out-of-market coal unit in Massachusetts.
- Stranded costs and out-of-market contracts from restructuring can affect municipalities and cooperatives as well as investor-owned utilities. Mr. Graves assisted one debt-financed utility in an evaluation of its possibilities for reorganization, refinancing, and re-engineering to improve financial health and to lower rates. Sale and leaseback of generation, fuel contract renegotiation, targeted downsizing, spin-off of transmission, and new marketing programs were among the many components of the proposed new business plan.
- As a means of reducing supply commitment risk, some utilities have solicited offers for power contracts that grant the right but not the obligation to take power at some future date at a predetermined price, in exchange for an initial option premium payment. Mr. Graves assisted several of these utilities in the development of valuation models for comparing the asking prices to fair market values for option contracts. In addition, he has helped these clients develop estimates of the critical option valuation parameters, such as trend, volatility, and correlations of the future prices of electric power and the various fuel indexes proposed for pricing the optional power.
- For the World Bank and several investor-owned electric utilities, Mr. Graves presented tutorial seminars on applying methods of financial economics to the evaluation of power production investments. Techniques for using option pricing to appraise the value of flexibility (such as arises from fuel switching capability or small plant size) were emphasized. He has applied these methods in estimating the value of contingent contract terms in fuel contracts (such as price caps and floors) for natural gas pipelines.
- Mr. Graves prepared a review of empirical evidence regarding the stock market's reaction to alternative dividend, stock repurchase, and stock dividend policies for a major electric utility. Tax effects, clientele shifting, signaling, and ability to sustain any new policies into the future were evaluated. A one-time stock repurchase, with careful announcement wording, was recommended.
- For a division of a large telecommunications firm, Mr. Graves assisted in a cost benchmarking study, in which the costs and management processes for billing, service order and inventory, and software development were compared to the practices of other affiliates and competitors. Unit costs were developed at a level far more detailed than the company normally tracked, and numerical measures of

drivers that explained the structural and efficiency causes of variation in cost performance were identified. Potential costs savings of 10-50 percent were estimated, and procedures for better identification of inefficiencies were suggested.

- For an electric utility seeking to improve its plant maintenance program, Mr. Graves directed a study on the incremental value of a percentage point decrease in the expected forced outage rate at each plant owned and operated by the company. This defined an economic priority ladder for efforts to reduce outage that could be used in lieu of engineering standards for each plant's availability. The potential savings were compared to the costs of alternative schedules and contracting policies for preventive and reactive maintenance, in order to specify a cost reduction program.
- Mr. Graves conducted a study on the risk-adjusted discount rate appropriate to a publicly-owned electric utility's capacity planning. Since revenue requirements (the amounts being discounted) include operating costs in addition to capital recovery costs, the weighted average cost of capital for a comparable utility with traded securities may not be the correct rate for every alternative or scenario. The risks implicit in the utility's expansion alternatives were broken into component sources and phases, weighted, and compared to the risks of bonds and stocks to estimate project-specific discount rates and their probable bounds.

TESTIMONY

Direct testimony in regard to a claim for a share of lime consumption reduction costs obtained by Plum Point as one of SMEPA's power plant operator/suppliers, on behalf of SMEPA, before the American Arbitration Association in the matter of Southwest Mississippi Electric Power Association vs. Plum Point Energy Associates, Case No. 01-15-0002-6062, September 2016.

Direct, Rebuttal and Supplementary Rebuttal reports regarding damages from loss of a nuclear generation facility, on behalf of Southern California Edison Company, Edison Material Supply LLC., San Diego Gas and Electric Company and City of Riverside before the International Chamber of Commerce in the matter of Southern California Edison v. Mitsubishi Nuclear Energy Systems, Inc. and Mitsubishi Heavy Industries, Ltd., Case No. 19784/AGF/RD, July 27, 2015 (direct), January 19, 2016 (rebuttal) and March 14, 2016 (supplemental).

Direct report re determination of an appropriate level of return needed for Standard Offer Service (SOS), on behalf of Delmarva Power & Light Company and Potomac Electric Power Company before the Maryland Public Service, Case Nos. 9226 and 9232, July 24, 2015.

Direct testimony in regard to the prudence of its gas hedging, on behalf of Hope Gas, Inc., before the West Virginia Public Service Commission, Case No. 12-1070-G-30C, June 24, 2013.

Direct testimony on behalf of Public Service Company of New Mexico before the NM Public Regulation Commission re appropriate profit incentives for energy conservation activities, Case No. 12-00317-UT, October 5, 2012.

Rebuttal testimony on behalf of Rocky Mountain Power Company before the Public Service Commission of Utah in regard to hedging practices for natural gas supply, Docket 11-035-200, July 2012.

Rebuttal testimony on behalf of Rocky Mountain Power Company before the Public Service Commission of Wyoming in regard to gas supply hedging and loss-sharing, Docket No. 20000-405-ER-11, June 2012.

Direct testimony on behalf of Ohio Power Company before the PUC of Ohio in regard to performance of PJM capacity markets, in Ohio Power's application for its ESP service charges, Case No. 10-2929-EL-UNC, March 30, 2012.

Expert report and oral testimony on behalf of Pepco Holdings, Inc. before the Maryland Public Service Commission in regard to inadequacies in the MD PSC's RFP for new combined cycle generation development in SWMAAC, Case No. 9214, January 31, 2012.

Direct testimony on behalf of Columbus Southern Power Company and Ohio Power Company before the Public Utilities Commission of Ohio in the Matter of the Commission

Review of the Capacity Charges of Ohio Power Company and Columbus Southern Power Company, Case No. 10-2929 -EL-UNC, August 31, 2011.

Rebuttal report on spent nuclear fuel removal on behalf of Yankee Atomic Electric Company, Connecticut Yankee Atomic Power Company, Maine Yankee Atomic Power Company before the United States Court of Federal Claims, Nos. 07-876C, No. 07-875C, No. 07-877C, August 5, 2011.

Direct Testimony on rehearing regarding the allowance of swaps in Rocky Mountain Power's fuel adjustment cost recovery mechanism, on behalf of Rocky Mountain Power before the Public Service Commission of the State of Utah, July 2011.

Comments and Reply Comments on capacity procurement and transmission planning on behalf of New Jersey Electric Distribution Companies before the State of New Jersey Board of Public Utilities in the Matter of the Board's Investigation of Capacity Procurement and Transmission Planning, NJ BPU Docket No. EO11050309, June 17, 2011; July 12, 2011.

Rebuttal testimony regarding Rocky Mountain Power's hedging practices on behalf of Rocky Mountain Power before the Public Service Commission of the State of Utah, Docket No. 10-035-124, June 2011.

Expert and Rebuttal reports regarding contract termination damages, on behalf of Hess Corporation before the United States District Court for the Northern District of New York, Case No. 5:10-cv-587 (NPM/GHL), April 29, 2011, May 13, 2011.

Expert and Rebuttal reports on spent fuel removal at Rancho Seco nuclear power plant, on behalf of Sacramento Municipal Utility District before the U.S. Court of Federal Claims, No. 09-587C, October 2010, July 1, 2011.

Rebuttal testimony on the Impacts of the Merger with First Energy on retail electric competition in Pennsylvania, on behalf of Allegheny Power before the Pennsylvania Public Utility Commission, Docket Nos. A-2010-2176520 and A-2010-2176732, September 13, 2010.

Expert and Rebuttal reports on the interpretation of pricing terms in a long term power purchase agreement, on behalf of Chambers Cogeneration Limited Partnership before the Superior Court of New Jersey, Docket No. L-329-08, August 23, 2010, September 21, 2010.

Expert and Rebuttal reports on spent fuel removal at Trojan nuclear facility, on behalf of Portland General Electric Company, The City of Eugene, Oregon, and PacifiCorp before the United States Court of Federal Claims No. 04-0009C, August 2010, June 29, 2011.

Rebuttal and Rejoinder testimonies on the approval of its Smart Meter Technology Procurement and Installation Plan before the Pennsylvania Public Utility Commission on behalf of West Penn Power Company d/b/a Allegheny Power, Docket No. M-2009-2123951, October 27, 2009, November 6, 2009.

Supplemental Direct testimony on the need for an energy cost adjustment mechanism in Utah to recover the costs of fuel and purchased power, on behalf of Rocky Mountain Power before the Public Service Commission of Utah, Docket No. 09-035-15, August 2009.

Expert and Rebuttal reports on spent nuclear fuel removal on behalf of Yankee Atomic Electric Company, Connecticut Yankee Atomic Power Company, Maine Yankee Atomic Power Company before the United States Court of Federal Claims, Nos. 98-126C, No. 98-154C, No. 98-474C, April 24, 2009, July 20, 2009.

Expert report in regard to opportunistic under-collateralization of affiliated trading companies, on behalf of BJ Energy, LLC, Franklin Power LLC, GLE Trading LLC, Ocean Power LLC, Pillar Fund LLC and Accord Energy, LLC before the United States District Court for the Eastern District of Pennsylvania, No. 09-CV-3649-NS, March 2009.

Rebuttal report in regard to appropriate discount rates for different phases of long-term leveraged leases, on behalf of Wells Fargo & Co. and subsidiaries, Docket No. 06-628T, January 15, 2009.

Oral and written direct testimony regarding resource procurement and portfolio design for Standard Offer Service, on behalf of PEPCo Holdings Inc. in its Response to Maryland Public Service Commission, Case No. 9117, October 1, 2008 and December 15, 2008.

Direct testimony regarding considerations affecting the market price of generation service for Standard Service Offer (SSO) customers, on behalf of Ohio Edison Company, et al., Docket 08-125, July 24, 2008.

Direct testimony in support of Delmarva's "Application for the Approval of Land-Based Wind Contracts as a Supply Source for Standard Offer Service Customers," on behalf of Delmarva Power & Light Company before the Public Service Commission of Delaware, July 24, 2008.

Oral direct testimony in regard to the Government's performance in accepting spent nuclear fuel under contractual obligations established in 1983, on behalf of plaintiff Dairyland Power Cooperative before the United States Court of Federal Claims (No. 04-106C), July 17, 2008.

Direct testimony for Delmarva Power & Light on risk characteristics of a possible managed portfolio for Standard Offer Service, as part of Delmarva's IRP filings (PSC Docket No. 07-20), March 20, 2008 and May 15, 2008.

Oral direct testimony regarding the economic substance of a cross-border lease-to-service contract for a German waste-to-energy plant on behalf of AWG Leasing Trust and KSP Investments, Inc before U. S. District Court, Northern District of Ohio, Eastern Division, Case No. 1:07CV0857, January 2008.

Expert report (October 15, 2007) and oral testimony (September 21 and 22, 2010) in Commonwealth of Pennsylvania Department of Environmental Protection, et al., v.

Allegheny Energy Inc, et al. regarding flaws in the plaintiffs' assessment of emissions attributed to repairs at certain power plants, Civil Action No. 2:05ev1885.

Direct testimony regarding portfolio management alternatives for supplying Standard Offer Service, on behalf of Potomac Electric Power Company and Delmarva Power & Light Company before the Public Service Commission of Maryland, Case No. 9117, September 14, 2007.

Direct testimony in regard to preconditions for effective retail electric competition, on behalf of New West Energy Corporation before the Arizona Commerce Commission, Docket No. E-03964A-06-0168, August 31, 2007.

Direct and rebuttal testimonies regarding the application of OG&E for an order of commission granting preapproval to construct Red Rock Generating Facility and authorizing a recovery rider, on behalf of Oklahoma Gas & Electric Company (OG&E) before the Corporation Commission of the State of Oklahoma, Case No. PUD 200700012, January 17, 2007 and June 18, 2007.

Testimony in regard to whether defendant's role in accounting misrepresentations could be reliably associated with losses to shareholders, on behalf of defendant Mark Kaiser before U.S. District Court of New York SI:04Cr733 (TPG).

Rebuttal testimony on proposed benchmarks for evaluating the Illinois retail supply auctions, on behalf of Midwest Generation EME L.L.C. and Edison Mission Marketing and Trading before the Illinois Commerce Commission Docket No. 06-0800, April 6, 2007.

Direct and rebuttal testimonies on the shareholder impacts of Dynegy's Project Alpha for the sentencing of Jamie Olis, on behalf of the U.S. Department of Justice before the United States District Court, Southern District of Texas, Houston Division, Criminal No. H-03-217, September 12, 2006.

Direct and rebuttal testimony on the need for POLR rate cap relief for Metropolitan Edison and Pennsylvania Electric and the prudence of their past supply procurement for those obligations, on behalf of FirstEnergy Corp before the Pennsylvania Public Utility Commission, Docket Nos. R-00061366 and R-00061367, August 24, 2006.

Direct testimony regarding Deutsche Bank Entities' opposition to Enron Corp's amended motion for class certification, on behalf of the Deutsche Bank Entities before the United States District Court, Southern District of Texas, Houston Division, Docket No. H-01-3624, February 2006.

Expert and Rebuttal reports regarding the non-performance of the U.S. Department of Energy in accepting spent nuclear fuel under the terms of its contract, on behalf of Pacific Gas and Electric Company before the United States Court of Federal Claims, Docket No. 04-0074C, into which has been consolidated No. 04-0075C, November 2005.

Direct testimony regarding the appropriate load caps for a POLR auction, on behalf of Midwest Generation EME, LLC before the Illinois Commerce Commission, Docket No. 05-0159, June 8, 2005.

Affidavit regarding unmitigated market power arising from the proposed Exelon—PSEG Merger, on behalf of Dominion Energy, Inc. before the Federal Energy Regulatory Commission, Docket No. EC05-43-000, April 11, 2005.

Expert and rebuttal reports and oral testimonies before the American Arbitration Association on behalf of Liberty Electric Power, LLC, Case No. 70 198 4 00228 04, December 2004, regarding damages under termination of a long-term tolling contract.

Oral direct and rebuttal testimony before the United States Court of Federal Claims on behalf of Connecticut Yankee Atomic Power Company, Docket No. 98-154 C, July 2004 (direct) and August 2004 (rebuttal), regarding non-performance of the U.S. Department of Energy in accepting spent nuclear fuel under the terms of its contract.

Direct, supplemental and rebuttal testimony before the Public Service Commission of Wisconsin, on behalf of Wisconsin Public Service Corporation and Wisconsin Power and Light Company, Docket No. 05-EI-136, February 27, 2004 (direct), May 4, 2004 (supplemental) and May 28, 2004 (rebuttal) in regard to the benefits of the proposed sale of the Kewaunee nuclear power plant.

Testimony before the Public Utility Commission of Texas on behalf of CenterPoint Energy Houston Electric LLC, Reliant Energy Retail Services LLC, and Texas Genco LP, Docket No. 29526, March 2004 (direct) and June 2004 (rebuttal), in regard to the effect of Genco separation agreements and financial practices on stranded costs and on the value of control premiums implicit in Texas Genco Stock price.

Rebuttal and additional testimony before the Illinois Commerce Commission, on behalf of Peoples Gas Light and Coke Company, Docket No. 01-0707, November 2003 (rebuttal) and January 2005 (additional rebuttal), in regard to prudence of gas contracting and hedging practices.

Rebuttal testimony before the State Office of Administrative Hearings on behalf of Texas Genco and CenterPoint Energy, Docket No. 473-02-3473, October 23, 2003, regarding proposed exclusion of part of CenterPoint's purchased power costs on grounds of including "imputed capacity" payments in price.

Rebuttal testimony before the Federal Energy Regulatory Commission (FERC) on behalf of Ameren Energy Generating Company and Union Electric Company, Docket No. EC03-53-000, October 6, 2003, in regard to evaluation of transmission limitations and generator responsiveness in generation procurement.

Rebuttal testimony before the New Jersey Board of Public Utilities on behalf of Jersey Central Power & Light Company, Docket No. ER02080507, March 5, 2003, regarding the prudence of JCP&L's power purchasing strategy to cover its provider-of-last-resort obligation.

Oral testimony (February 17, 2003) and expert report (April 1, 2002) before the United States District Court, Southern District of Ohio, Eastern Division on behalf of Ohio Edison Company and Pennsylvania Power Company, Civil Action No. C2-99-1181, regarding coal plant maintenance projects alleged to trigger New Source Review.

Expert Report before the United States District Court on behalf of Duke Energy Corporation, Docket No. 1:00CV1262, September 16, 2002, regarding forecasting changes in air pollutant emissions following coal plant maintenance projects.

Direct testimony before the Public Utility Commission of Texas on behalf of Reliant Energy, Inc., Docket No. 26195, July 2002, regarding the appropriateness of Reliant HL&P's gas contracting, purchasing and risk management practices, and standards for assessing HL&P's gas purchases.

Direct and rebuttal testimonies before the Public Utilities Commission of the State of California on behalf of Southern California Edison, Application No. R. 01-10-024, May 1, 2002, and June 5, 2002, regarding Edison's proposed power procurement and risk management strategy, and the regulatory guidelines for reviewing its procurement purchases.

Rebuttal testimony before the Texas Public Utility Commission on behalf of Reliant Resources, Inc., Docket No. 24190, October 10, 2001, regarding the good-cause exception to the substantive rules that Reliant Resources, Inc. and the staff of the Public Utility Commission sought in their Provider of Last Resort settlement agreement.

Direct testimony before the Federal Energy Regulatory Commission (FERC) on behalf of Northeast Utilities Service Company, Docket No. ER01-2584-000, July 13, 2001, in regard to competitive impacts of a proposed merchant transmission line from Connecticut to Long Island.

Direct testimony before the Vermont Public Service Board on behalf of Vermont Gas Systems, Inc., Docket No. 6495, April 13, 2001, regarding Vermont Gas System's proposed risk management program and deferred cost recovery account for gas purchases.

Affidavit on behalf of Public Service Company of New Mexico, before the Federal Energy Regulatory Commission (FERC), Docket No. ER96-1551-000, March 26, 2001, to provide an updated application for market based rates.

Affidavit on behalf of the New York State Electric and Gas Corporation, April 19, 2000, before the New York State Public Service Commission, In the Matter of Customer Billing Arrangements, Case 99-M-0631.

Supplemental Direct and Reply Testimonies of Frank C. Graves and A. Lawrence Kolbe (jointly) on behalf of Southern California Edison Company, Docket Nos. ER97-2355-00, ER98-1261-000, ER98-1685-000, November 1, 1999, regarding risks and cost of capital for transmission services.

Expert report before the United States Court of Federal Claims on behalf of Connecticut Yankee Atomic Power Company, Connecticut Yankee Atomic Power Company, Plaintiff v. United States of America, No. 98-154 C, June 30, 1999, regarding non-performance of the U.S. Department of Energy in accepting spent nuclear fuel under the terms of its contract.

Expert report before the United States Court of Federal Claims on behalf of Maine Yankee Atomic Power Company, Maine Yankee Atomic Power Company, Plaintiff v. United States of America, No. 98-474 C, June 30, 1999, regarding the damages from non-performance of the U.S. Department of Energy in accepting spent nuclear fuel and high-level waste under the terms of its contract.

Expert report before the United States Court of Federal Claims on behalf of Yankee Atomic Electric Company, Yankee Atomic Electric Company, Plaintiff v. United States of America, No. 98-126 C, June 30, 1999, regarding the damages from non-performance of the U.S. Department of Energy in accepting spent nuclear fuel and high-level waste under the terms of its contract.

Prepared direct testimony before the Federal Energy Regulatory Commission on behalf of National Rural Utilities Cooperative Finance Corporation, Inc., Cities of Anaheim and Riverside, California v. Deseret Generation & Transmission Cooperative, Docket No. EL97-57-001, March 1999, regarding cost of service for rural cooperatives versus investor-owned utilities, and coal plant valuation.

Expert report and oral examination before the Independent Assessment Team for industry restructuring appointed by the Alberta Energy and Utilities Board on behalf of TransAlta Utilities Corporation, January 1999, regarding the cost of capital for generation under long-term, indexed power purchase agreements.

Oral testimony before the Commonwealth of Massachusetts Appellate Tax Board on behalf of Indeck Energy Services of Turners Falls, Inc., Turners Falls Limited Partnership, Appellant vs. Town of Montague, Board of Assessors, Appellee, Docket Nos. 225191-225192, 233732-233733, 240482-240483, April 1998, regarding market conditions and revenues assessment for property tax basis valuation.

Direct and joint supplemental testimony before the Pennsylvania Public Utility Commission on behalf of Pennsylvania Electric Company and Metropolitan Edison Company, No. R-00974009, et al., December 1997, regarding market clearing prices, inflation, fuel costs, and discount rates.

Direct Testimony before the Pennsylvania Public Utilities Commission on behalf of UGI Utilities, Inc., Docket No. R-00973975, August 1997, regarding forecasted wholesale market energy and capacity prices.

Testimony before the Public Utilities Commission of the State of California on behalf of the Southern California Edison Company, No. 96-10-038, August 1997, regarding anticompetitive implications of the proposed Pacific Enterprises/ENOVA mergers.

Direct and supplemental testimony before the Kentucky Public Service Commission on behalf of Big Rivers Electric Corporation, No. 97-204, June 1997, regarding wholesale generation and transmission rates under the bankruptcy plan of reorganization.

Affidavit before the Federal Energy Regulation Commission on behalf of the Southern California Edison Company in Docket No. EC97-12-000, March 28, 1997, filed as part of motion to intervene and protest the proposed merger of Enova Corporation and Pacific Enterprises.

Direct, rebuttal, and supplemental rebuttal testimony before the State of New Jersey Board of Public Utilities on behalf of GPU Energy, No. EO97070459, February 1997, regarding market clearing prices, inflation, fuel costs, and discount rates.

Oral direct testimony before the State of New York on behalf of Niagara Mohawk Corporation in Philadelphia Corporation, et al. v. Niagara Mohawk, No. 71149, November 1996, regarding interpretation of low-head hydro IPP contract quantity limits.

Oral direct testimony before the State of New York on behalf of Niagara Mohawk Corporation in Black River Limited Partnership v. Niagara Mohawk Power Corporation, No. 94-1125, July 1996, regarding interpretation of IPP contract language specifying estimated energy and capacity purchase quantities.

Oral direct testimony on behalf of Eastern Utilities Associates before the Massachusetts Department of Public Utilities, No. 96-100 and 2320, July 1996, regarding issues in restructuring of Massachusetts electric industry for retail access.

Affidavit before the Kentucky Public Service Commission on behalf of Big Rivers Electric Corporation in PSC Case No. 94-032, June 1995, regarding modifications to an environmental surcharge mechanism.

Rebuttal testimony on behalf of utility in Eastern Energy Corporation v. Commonwealth Electric Company, American Arbitration Association, No. 11 Y 198 00352 04, March 1995, regarding lack of net benefits expected from a terminated independent power project.

Direct testimony before the Pennsylvania Public Utility Commission on behalf of Pennsylvania Power & Light Company in Pennsylvania Public Utility Commission et al. v. UGI Utilities, Inc., Docket No. R-932927, March 1994, regarding inadequacies in the design and pricing of UGI's proposed unbundling of gas transportation services.

Direct testimony before the Pennsylvania Public Utility Commission, on behalf of Interstate Energy Company, Application of Interstate Energy Company for Approval to Offer Services in the Transportation of Natural Gas, Docket No. A-140200, October 1993, and rebuttal testimony, March 1994.

Direct testimony before the Pennsylvania Public Utility Commission, on behalf of Procter & Gamble Paper Products Company, Pennsylvania Public Utility Commission v. Pennsylvania Gas and Water Company, Docket No. R-932655, September 1993, regarding PG&W's proposed charges for transportation balancing.

Oral rebuttal testimony before the American Arbitration Association, on behalf of Babcock and Wilcox, File No. 53-199-00127-92, May 1993, regarding the economics of an incentive clause in a cogeneration operations and maintenance contract.

Answering testimony before the Federal Energy Regulatory Commission, on behalf of CNG Transmission Corporation, Docket No. RP88-211-000, March 1990, regarding network marginal costs associated with the proposed unbundling of CNG.

Direct testimony before the Federal Energy Regulatory Commission, on behalf of Consumers Power Company, et al., concerning the risk reduction for customers and the performance incentive benefits from the creation of Palisades Generating Company, Docket No. ER89-256-000, October 1989, and rebuttal testimony, Docket No. ER90-333-000, November 1990.

Direct testimony before the New York Public Service Commission, on behalf of Consolidated Natural Gas Transmission Corporation, Application of Empire State Pipeline for Certificate of Public Need, Case No. 88-T-132, June 1989, and rebuttal testimony, October, 1989.

PUBLICATIONS, PAPERS, AND PRESENTATIONS

"Managing Price Risk for Merchant Renewable Investments: Role of Market Interactions and Dynamics on Effective Hedging Strategies" (with Onur Aydin and Bente Villadsen), Brattle Whitepaper, January 2017.

"Cap-and-Trade Program in California: Will Low GHG Prices Last Forever?" (with Yingxia Yang, Michael Hagerty, Ashley Palmarozzo and Metin Celebi), Brattle Whitepaper, January 2017.

"DER Incentive Mechanisms as a Bridge to the Utility of the Future," SNL Conference, Washington, DC, December 14 and 15, 2016.

"Economic Outlook for U.S. Nuclear Power -- Challenges and Opportunities," CSIS Nuclear Conference, October 24, 2016.

"Computerized and High-Frequency Trading" (with Michael Goldstein and Pavitra Kumar), *The Financial Review*, May 2014.

"LDC Procurement and Hedging" (with Steve Levine), Prepared for the American Gas Association Energy Market Regulation Conference, New Orleans, LA, October 2014.

"*Brattle Review of AE Planning Methods and Austin Task Force Report.*" (with Bente Villadsen), Prepared for Austin Energy, September 24, 2014.

"How will the EPA's Clean Power Plan Impact Wind?" (with Kathleen Spees), *North American Wind Power*, Vol. 11, No. 7, July 2014.

"Low Voltage Resiliency Insurance: Ensuring Critical Service Continuity During Major Power Outages," *The Public Utilities Fortnightly*, Vol. 151, No. 9, September 2013.

"How Much Gas is Too Much?," Law Seminars International Electric Utility Rate Cases Conference, Las Vegas, NV, February 21, 2013.

"Potential Coal Plant Retirements—2012 Update" (with Metin Celebi and Charles Russell), Brattle Whitepaper, October 2012.

"Centralized Dry Storage of Nuclear Fuel—Lessons for U.S. Policy from Industry Experience and Fukushima" (with Mariko R. Geronimo and Glen A. Graves), Brattle Whitepaper, August 2012.

"Beyond Retrofit/Retirement: Complex Decisions for Coal Units" (with Metin Celebi and Chip Russell), Brattle Whitepaper, April 16, 2012.

"The Emerging Need for Greater Gas-Electric Industry Coordination" (with Matthew O'Loughlin, Steve Levine, Anul Thapa and Metin Celebi), as comments to the FERC NOI, Docket AD12-12-000, regarding gas-electric industry reliability issues, March 30, 2012.

"Gas Volatility Outlook and Implications," Law Seminars International Electric Utility Rate Cases Conference, Las Vegas, Nevada, February 23, 2012.

"Public Sector Discount Rates" (Bin Zhou and Bente Villadsen), Brattle Whitepaper, September 2011

"Trading at the Speed of Light: The Impact of High-Frequency Trading on Market Performance, Regulatory Oversight, and Securities Litigation" (with Pavitra Kumar and Michael Goldstein), 2011 No. 2, Brattle Whitepaper in Finance.

"Dodd-Frank and Its Impact on Hedging Strategies," Law Seminars International Electric Utility Rate Cases Conference, February 10, 2011.

"Potential Coal Plant Retirements Under Emerging Environmental Regulations" (with Metin Celebi), December 2010.

"Risk-Adjusted Damages Calculation in Breach of Contract Disputes: A Case Study" (with Bin Zhou, Melvin Brosterman, and Quinlan Murphy), *Journal of Business Valuation and Economic Loss Analysis* 5, No. 1, October 2010.

"Gas Price Volatility and Risk Management," (with Steve Levine), AGA Energy Market Regulation Conference, Seattle, WA, September 30, 2010.

"Managing Natural Gas Price Volatility: Principles and Practices across the Industry" (with Steve Levine), American Clean Skies Foundation Task Force on Ensuring Stable Natural Gas Markets, July 2010.

"A Changing Environment for Distcos," NMSU Center for Public Utilities, The Santa Fe Conference, March 15, 2010.

"Prospects for Natural Gas Under Climate Policy Legislation: Will There Be a Boom in Gas Demand?" (with Steve Levine and Metin Celebi), The Brattle Group, Inc., March 2010.

"Gas Price Volatility and Risk Management" (with Steve Levine), Law Seminars International Rate Cases: Current Issues and Strategies, Las Vegas, NV, February 11, 2010.

"Hedging Effects of Wind on Retail Electric Supply Costs" (with Julia Litvinova), *The Electricity Journal*, Vol. 22, No. 10, December 2009.

"Overview of U.S. Electric Policy Issues," Los Alamos Education Committee, June 2009.

"IRP Challenges of the Coming Decade" NARUC Conference, Washington, DC, February 17, 2009.

"Volatile CO2 Prices Discourage CCS Investment" (with Metin Celebi), The Brattle Group, Inc., January 2009.

"Drivers of New Generation Development—A Global Review" (with Metin Celebi), EPRI, 2008.

"Utility Supply Portfolio Diversity Requirements" (with Philip Q Hanser), *The Electricity Journal*, Vol. 20, No. 5, June 2007, pp. 22-32.

"Electric Utility Automatic Adjustment Clauses: Why They Are Needed Now More Than Ever" (with Philip Q Hanser and Greg Basheda), *The Electricity Journal*, Vol. 20, No. 5, June 2007, pp. 33-47.

"Rate Shock Mitigation," (with Greg Basheda and Philip Q Hanser), prepared for the Edison Electric Institute (EEI), May, 2007.

"PURPA Provisions of EPAct 2005: Making the Sequel Better than the Original" presented at Center for Public Utilities Advisory Council—New Mexico State University Current Issues Conference 2006, Santa Fe, New Mexico, March 21, 2006.

"The New Role of Regulators in Portfolio Selection and Approval" (with Joseph B. Wharton), presented at EUCI Resource and Supply Planning Conference, New Orleans, November 4, 2004.

"Disincentives to Utility Investment in the Current World of Competitive Regulation" (with August Baker), prepared for the Edison Electric Institute (EEI), October, 2004.

"Power Procurement for Second-Stage Retail Access" (with Greg Basheda), presented at Illinois Commerce Commission's 'Post 2006 Symposium', Chicago, IL, April 29, 2004.

"Utility Investment and the Regulatory Compact" (with August Baker), presented to NMSU Center for Public Utilities Advisory Council, Santa Fe, New Mexico, March 23, 2004.

"How Transmission Grids Fail" (with Martin L. Baughman) presented to NARUC Staff Subcommittee on Accounting and Finance, Spring 2004 Meeting, Scottsdale, Arizona, March 22, 2004.

"Resource Planning & Procurement in Restructured Electricity Markets," presented to NARUC Winter Committee Meetings, Washington, DC, March 9, 2004.

"Resource Planning and Procurement in Evolving Electricity Markets" (with James A. Read and Joseph B. Wharton), white paper for Edison Electric Institute (EEI), January 31, 2004.

"Transmission Management in the Deregulated Electric Industry—A Case Study on Reactive Power" (with Judy W. Chang and Dean M. Murphy), *The Electricity Journal*, Vol. 16, Issue 8, October, 2003.

"Flaws in the Proposed IRS Rule to Reinstate Amortization of Deferred Tax Balances Associated with Generation Assets Reorganized in Industry Restructuring" (with Michael J. Vilbert), white paper for Edison Electric Institute (EEI) to the IRS, July 25, 2003.

"Resource Planning & Procurement in Restructured Electricity Markets" (with James A. Read and Joseph B. Wharton), presented at Northeast Mid-Atlantic Regional Meeting of Edison Electrical Institute, Philadelphia, PA, May 6, 2003 and at Midwest Regional Meeting, Chicago, IL, June 18, 2003.

"New Directions for Safety Net Service—Pricing and Service Options" (with Joseph B. Wharton), white paper for Edison Electric Institute (EEI), May 2003.

"Volatile Markets Demand Change in State Regulatory Evaluation Policies" (with Steven H. Levine), chapter 20 of *Electric & Natural Gas Business: Understanding It!*, edited by Robert E. Willett, Financial Communications Company, Houston, TX, February 2003, pp. 377-405.

"New York Power Authority Hydroelectric Project Production Rates," report prepared for NYPA (New York Power Authority) on the embedded costs of production of ancillary services at the Niagara and St. Lawrence hydroelectric projects, 2001-2006, January 22, 2003.

"Regulatory Policy Should Encourage Hedging Programs" (with Steven H. Levine), *Natural Gas*, Vol. 19, No. 4, November 2002.

"Measuring Gas Market Volatility—A Survey" (with Paolo Coghe and Manuel Costescu), presented at the Stanford Energy Modeling Forum, Washington, DC, June 24, 2002.

"Unbundling and Rebundling Retail Generation Service: A Tale of Two Transitions" (with Joseph B. Wharton), presented at the Edison Electric Institute Conference on Unbundling/Rebundling Utility Generation and Transmission, New Orleans, LA, February 25, 2002.

"Regulatory Design for Reactive Power and Voltage Support Services" (with Judy W. Chang), prepared for Comision de Regulacion de Energia y Gas, Bogotá, Colombia, December 2001.

"Provider of Last Resort Service Hindering Retail Market Development" (with Joseph B. Wharton), *Natural Gas*, Vol. 18, No. 3, October 2001.

"Strategic Management of POLR Obligations" presented at Edison Electric Institute and the Canadian Electricity Association Conference, New Orleans, LA, June 5, 2001.

"Measuring Progress Toward Retail Generation Competition" (with Joseph B. Wharton) Edison Electric Institute E-Forum presentation, May 16, 2001.

"International Review of Reactive Power Management" (with Judy W. Chang), presented to Comision de Regulacion de Energia y Gas, Bogotá, Colombia, May 4, 2001.

"POLR and Progress Towards Retail Competition—Can Kindness Kill the Market?" (with Joseph B. Wharton), presented at the NARUC Winter Committee Meeting, Washington, DC, February 27, 2001.

"What Role for Transitional Electricity Price Protections After California?" presented to the Harvard Electricity Policy Group, 24th Plenary Session, San Diego, CA, February 1, 2001.

"Estimating the Value of Energy Storage in the United States: Some Case Studies" (with Thomas Jenkin, Dean Murphy and Rachel Polimeni) prepared for the Conference on Commercially Viable Electricity Storage, London, England, January 31, 2001.

"PBR Designs for Transcos: Toward a Competitive Framework" (with Steven Stoft), *The Electricity Journal*, Vol. 13, No. 7, August/September 2000.

"Capturing Value with Electricity Storage in the Energy and Ancillary Service Markets" (with Thomas Jenkin, Dean Murphy and Rachel Polimeni) presented at EESA'T, Orlando, Florida, September 18, 2000.

"Implications of ISO Design for Generation Asset Management" (with Edo Macan and David A. Andrade), presented at the Center for Business Intelligence's Conference on Pricing Power Products & Services, Chicago, Illinois, October 14-15, 1999.

"Residual Service Obligations Following Industry Restructuring" (with James A. Read, Jr.), paper and presentation at the Edison Electric Institute Economic Regulation and Competition Committee Meeting, Longboat Key, Florida, September 26-29, 1999. Also presented at EEI's 1999 Retail Access Conference: *Making Retail Competition Work*, Chicago, Illinois, September 30-October 1, 1999.

"Opportunities for Electricity Storage in Deregulating Markets" (with Thomas Jenkin and Dean Murphy), *The Electricity Journal*, Vol. 12, No. 8, October 1999.

How Competitive Market Dynamics Affect Coal, Nuclear and Gas Generation and Fuel Use - A 10 Year Look Ahead (with L. Borucki, R. Broehm, S. Thumb, and M. Schaal), Final Report, May 1999, TR-111506 (Palo Alto, CA: Electric Power Research Institute, 1999).

"Price Caps for Standard Offer Service: A Hidden Stranded Cost" (with Paul Liu), *The Electricity Journal*, Vol. 11, No. 10, December 1998.

Mechanisms for Evaluating the Role of Hydroelectric Generation in Ancillary Service Markets (with R.P. Broehm, R.L. Earle, T.J. Jenkin, and D.M. Murphy), Final Report, November 1998, TR-111707 (Palo Alto, CA: Electric Power Research Institute, 1998).

"PJM Market Competition Evaluation White Paper," (with Philip Hanser), prepared for PJM, L.L.C., October, 1998.

"The Role of Hydro Resources in Supplying System Support and Ancillary Services," presented at the EPRI Generation Assets Management Conference, Baltimore, Maryland, July 13-15, 1998. Published in *EPRI Generation Assets Management 1998 Conference: Opportunities and Challenges in the Electric Marketplace*, Proceedings, November 1998, TR-111345 (Palo Alto, CA: EPRI GEN, Inc., 1998).

"Regional Impacts of Electric Utility Restructuring on Fuel Markets" (with S.L. Thumb, A.M. Schaal, L.S. Borucki, and R. Broehm), presented at the EPRI Generation Assets Management Conference, Baltimore, Maryland, July 13-15, 1998. Published in *EPRI Generation Assets Management 1998 Conference: Opportunities and Challenges in the Electric Marketplace*, Proceedings, November 1998, TR-111345 (Palo Alto, CA: EPRIGEN, Inc., 1998).

Energy Market Impacts of Electric Industry Restructuring: Understanding Wholesale Power Transmission and Trading (with S.L. Thumb, A.M. Schaal, L.S. Borucki, and R. Broehm), Final Report, March 1998, EPRI TR-108999, GRI-97/0289 (Palo Alto, CA: Electric Power Research Institute, 1998).

"Pipeline Pricing to Encourage Efficient Capacity Resource Decisions" (with Paul R. Carpenter and Matthew P. O'Loughlin), filed in FERC proceedings *Financial Outlook for the Natural Gas Pipeline Industry*, Docket No. PL98-2-000, February 1998.

"One-Part Markets for Electric Power: Ensuring the Benefits of Competition" (with E. Grant Read, Philip Q. Hanser, and Robert L. Earle), Chapter 7 in *Power Systems Restructuring: Engineering and Economics*, M. Ilić, F. Galiana, and L. Fink, eds. (Boston: Kluwer Academic Publishers, 1998, reprint 2000), pp. 243-280.

"Railroad and Telecommunications Provide Prior Experience in 'Negotiated Rates'" (with Carlos Lapuerta), *Natural Gas*, Vol. 13, No. 12, July 1997.

"Considerations in the Design of ISO and Power Exchange Protocols: Procurement Bidding and Market Rules" (with J.P. Pfeifenberger), presented at the Electric Utility Consultants Bulk Power Markets Conference, Vail, Colorado, June 3-4, 1997.

"The Economics of Negative Barriers to Entry: How to Recover Stranded Costs and Achieve Competition on Equal Terms in the Electric Utility Industry" (with William B. Tye), *Electric Industry Restructuring*, *Natural Resources Journal*, Vol. 37, No. 1, Winter 1997.

"Capacity Prices in a Competitive Power Market" (with James A. Read), *The Virtual Utility: Accounting, Technology & Competitive Aspects of the Emerging Industry*, S. Awerbuch and A. Preston, eds. (Boston: Kluwer Academic Publishers, 1997), pp. 175-192.

"Stranded Cost Recovery and Competition on Equal Terms" (with William B. Tye), *Electricity Journal*, Vol. 9, No. 10, December 1996.

"Basic and Enhanced Services for Recourse and Negotiated Rates in the Natural Gas Pipeline Industry" (with Paul R. Carpenter, Carlos Lapuerta, and Matthew P. O'Loughlin), filed on behalf of Columbia Gas Transmission Corporation and Columbia Gulf Transmission Company, in its *Comments on Negotiated Rates and Terms of Service*, FERC Docket No. RM96-7, May 29, 1996.

"Premium Value for Hydro Power in a Deregulated Industry? Technical Opportunities and Market Structure Effects," presented to the *EPRI Hydro Steering Committee Conference*,

Chattanooga, Tennessee, April 19, 1996, and to the *EPRI Energy Storage Benefits Workshop*, New Orleans, Louisiana, May 22, 1996.

"Distributed Generation Technology in a Newly Competitive Electric Power Industry" (with Johannes P. Pfeifenberger, Paul R. Ammann, and Gary A. Taylor), presented at the *American Power Conference*, Illinois Institute of Technology, April 10, 1996.

"A Framework for Operations in the Competitive Open Access Environment" (with Marija D. Ilić, Lester H. Fink, Albert M. DiCaprio), *Electricity Journal*, Vol. 9, No. 3, April 1996.

"Prices and Procedures of an ISO in Supporting a Competitive Power Market" (with Marija Ilić), presented at the *Restructuring Electric Transmission Conference*, Denver, Colorado, September 27, 1995.

"Potential Impacts of Electric Restructuring on Fuel Use," *EPRI Fuel Insights*, Issue 2, September 1995.

"Optimal Use of Ancillary Generation Under Open Access and its Possible Implementation" (with Maria Ilić), M.I.T. *Laboratory for Electromagnetic and Electronic Systems Technical Report*, LEES TR-95-006, August 1995.

"Estimating the Social Costs of PUHCA Regulation" (with Paul R. Carpenter), submitted to the Security and Exchange Commission's *Request for Comments on Modernization of the Regulation of Public Utility Holding Companies*, SEC File No. S7-32-93, February 6, 1995.

A Primer on Electric Power Flow for Economists and Utility Planners, TR-104604, The Electric Power Research Institute, EPRI Project RP2123-19, January 1995.

"Impacts of Electric Industry Restructuring on Distributed Utility Technology," presented to the Electric Power Research Institute/National Renewable Energy Laboratory/Florida Power Corporation *Conference on Distributed Generation*, Orlando, Florida, August 24, 1994.

"Pricing Transmission and Power in the Era of Retail Competition" (with Johannes P. Pfeifenberger), presented at the Electric Utility Consultants' *Retail Wheeling Conference*, Beaver Creek, Colorado, June 21, 1994.

"Pricing of Electricity Network Services to Preserve Network Security and Quality of Frequency Under Transmission Access" (with Dr. Marija Ilić, Paul R. Carpenter, and Assef Zobian), Response and Reply comments to the Federal Energy Regulatory Commission in its *Notice of Technical Conference on Transmission Pricing*, Docket No. RM-93-19-000, November 1993 and January 1994.

"Evaluating and Using CAAA Compliance Cost Forecasts," presented at the *EPRI Workshop on Clean Air Response*, St. Louis, Missouri, November 17 and Arlington, Virginia, November 19, 1992.

"Beyond Valuation—Organizational and Strategic Considerations in Capital Budgeting for Electric Utilities," presented at *EPRI Capital Budgeting Notebook Workshop*, New Orleans, Louisiana, April 9-10, 1992.

"Unbundling, Pricing, and Comparability of Service on Natural Gas Pipeline Networks" (with Paul R. Carpenter), as appendix to Comments on *FERC Order 636* filed by Interstate Natural Gas Association of America, November 1991.

"Estimating the Cost of Switching Rights on Natural Gas Pipelines" (with James A. Read, Jr. and Paul R. Carpenter), presented at the M.I.T. Center for Energy Policy Research, "Workshop on New Methods for Project and Contract Evaluation," March 2-4, 1988; and in *The Energy Journal*, Vol. 10, No. 4, October 1989.

"Demand-Charge GICs Differ from Deficiency-Charge GICs" (with Paul R. Carpenter), *Natural Gas & Electricity*, Vol. 6, No. 1, August 1989.

"What Price Unbundling?" (with P.R. Carpenter), *Natural Gas & Electricity*, Vol. 5, No. 11, June 1989.

"Price-Demand Feedback," presented at *EPRI Capital Budgeting Seminar*, San Diego, California, March 2-3, 1989.

"Applications of Finance to Electric Power Planning," presented at the World Bank, *Seminar on Risk and Uncertainty in Power System Planning*, October 13, 1988.

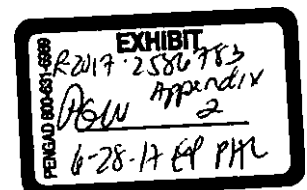
"Planning for Electric Utilities: The Value of Service" (with James A. Read, Jr.), in *Moving Toward Integrated Value-Based Planning*, Electric Power Research Institute, 1988.

"Valuation of Standby Charges for Natural Gas Pipelines" (with James A. Read, Jr. and Paul R. Carpenter), presented to M.I.T. Center for Energy Policy Research, October, 1987.

APPENDIX 2: SUPPORTING FIGURES

FCG Figure A – 1
Metric Formulas

Debt/Capitalization	Total Debt / Total Capitalization	$\text{Total Debt} = \text{Long-Term Debt} + \text{Short-Term Debt}$ <ul style="list-style-type: none"> Long-Term Debt includes both current and non-current portions of LT Debt, Capital Leases Short-Term Debt includes Notes Payable, Commercial Paper, etc. $\text{Total Capitalization} = \text{Total Debt} + \text{Total Equity (or Net Position)}$ <ul style="list-style-type: none"> Net Position: Assets + Deferred Outflows – Liabilities – Deferred Inflows
Operating Margin	Operating Income / (Operating Revenues – Purchased Commodity Costs)	$\text{Operating Income} = \text{Operating Expenses} - \text{Operating Revenues}$ <p>Purchased commodity costs excluded</p>
IGF/Revenues	(Operating Income – Depreciation + Amortization) / (Operating Revenues – Purchased Commodity Costs)	Purchased commodity costs excluded
FFO/CapEx	(Net Income + Depreciation + Amortization) / CapEx	CapEx corresponds to purchases of capital assets as recorded in cash flow statements; if cash flow statement is unavailable, CapEx is calculated as follows: Current Year Plant, Property, Equipment (PPE) – Previous Year PPE – Current Year Depreciation
Days Cash	Cash and Cash Equivalents / [(Operating Expenses – Depreciation – Amortization) / 365]	Purchased commodity costs included
FFO/Debt	(Net Income + Depreciation + Amortization) / 2-Year Average Total Debt	2-Year Average Total Debt = (Current Year Total Debt + Previous Year Total Debt) / 2; where Total Debt = Long-Term Debt + Short-Term Debt
FFO Coverage	(Net Income + Depreciation + Amortization + Interest) / Interest	
EBIT Coverage	(Net Income + Interest + Taxes) / Interest	
Interest-Only Debt Service Coverage	(Operating Income + Depreciation + Amortization + Interest Income) / Interest	



Debt Service Coverage (Principal & Interest)	$\frac{(\text{Operating Income} + \text{Depreciation} + \text{Amortization} + \text{Interest Income})}{(\text{Interest} + \text{Principal Paid on Long-Term Debt})}$	
CapEx/DA	$\text{CapEx} / (\text{Depreciation} + \text{Amortization})$	
Net Plant/Gross Plant	$\text{Net Plant} / \text{Gross Plant}$	
CapEx/Net Plant	$\text{CapEx} / \text{Net Plant}$	
Gas OpEx/Volume	$(\text{Gas Operating Expenses} - \text{Purchased Commodity Costs}) / \text{Volume}$	Volume denotes total gas sales volume (mcf) across residential, commercial, industrial, and other customer categories used in EIA 176 filings

Sources and Notes:

Fiscal years are not consistent across benchmarked companies, resulting in differing timestamps for data collected to calculate the above metrics. PGW data is reported on a September-August Financial Year. CPS Energy data is reported on a February-January Financial Year. Richmond Department of Public Utilities data is reported on a July-June Financial Year. JEA data is reported on a November-September Financial Year. All other financial data reflect a January-December Financial Year. Equity values do not reflect anticipated changes to equity resulting from GASB implementation. Municipal utilities are generally exempt from taxes, but are sometimes responsible for "payments in lieu of taxes" to the host municipality; these alternative tax payments have been considered regular taxes for purposes of calculating the above metrics. Data availability limited the collection of Richmond data to 2011-2014, and Seattle City data to 2012-2015. Merger-related data issues limited collection of Central Penn and Penn Natural Gas data to 2012-2015, and Peoples data to 2011-2013. FFO/CapEx for Peoples is calculated only for 2011 and 2012, due to merger-related anomalies for 2013 data for plant, property, and equipment (PPE).

FCG Figure A – 2
Credit Agency Metrics: Leverage & Risk, Liquidity

Rating Agency	Leverage & Risk	Liquidity
Fitch	<ul style="list-style-type: none"> • Equity/Capitalization • Debt Service/Cash Operating Expenses • Debt/Customer • Variable-Rate Debt/Total Debt • Net Debt/Net Capital Assets • Operating Margin 	<ul style="list-style-type: none"> • Days Cash on Hand • Days Liquidity on Hand
Moody's	<ul style="list-style-type: none"> • Debt to Operating Revenues • Oversized adjusted net pension liability relative to debt or significant actuarial required contribution* • Exposure to puttable debt, swaps, or other unusual debt structures* 	<ul style="list-style-type: none"> • Days Cash on Hand • Constrained liquidity due to oversized transfers (includes in lieu of tax payments)*
S&P	<ul style="list-style-type: none"> • Debt to Equity 	<ul style="list-style-type: none"> • Unrestricted Cash/Total Expenditures
PGW Benchmarking	<ul style="list-style-type: none"> • Debt / Capitalization • Operating Margin 	<ul style="list-style-type: none"> • Internally Generated Funds/Revenues • FFO/CapEx • Days Cash

Sources and Notes:

Fitch Ratings, "U.S. Public Power Rating Criteria: Sector-Specific Criteria," May 2015, amended March 25, 2016. Moody's Investor Service, "Rating Methodology: US Municipal Revenue Debt," December 2014. Standard & Poor's Rating Services, "Ratings Direct: Electric and Gas Utility Ratings," December 2014.

Asterisk indicates metric is an additional consideration. Metrics listed for S&P should not be considered exhaustive. Moody's days cash measure excludes funds restricted for capital. Fitch also uses a separate "days liquidity" measure to account for commercial paper, short-term borrowing, etc.

FCG Figure A – 3
Credit Agency Metrics: Solvency, Efficiency/Other

Credit Agency	Solvency	Efficiency/Other
Fitch	<ul style="list-style-type: none"> • Debt Service Coverage • Coverage of Full Obligations • Funds Available for Debt Service • Debt/FADS 	<ul style="list-style-type: none"> • CapEx/DA • Free Cash Flow/CapEx • General Fund Transfer/Operating Revenues
Moody's	<ul style="list-style-type: none"> • Debt Service Coverage • Debt Service Coverage below key indicators* • Outsized capital needs* 	
S&P	<ul style="list-style-type: none"> • Debt Service Coverage • Fixed Charge Coverage 	
PGW Benchmarking	<ul style="list-style-type: none"> • FFO/Debt • FFO Coverage • EBIT Coverage • Interest-Only Debt Service Coverage • Debt Service Coverage (Principal + Interest) 	<ul style="list-style-type: none"> • CapEx/DA • Net Plant/Gross Plant • CapEx/Net Plant

Sources and Notes:

Fitch Ratings. "U.S. Public Power Rating Criteria: Sector-Specific Criteria," May 2015, amended March 25, 2016. Moody's Investor Service. "Rating Methodology: US Municipal Revenue Debt," December 2014. Standard & Poor's Rating Services. "Ratings Direct: Electric and Gas Utility Ratings," December 2014.

Asterisk indicates metric is an additional consideration. Metrics listed for S&P should not be considered exhaustive. Rating agencies use both generic debt service coverage ratios and may also consider utility-specific covenant-based ratios. Fitch calculates ratios including and excluding the effects of payments in lieu of taxes (and similar payments).

FCG Figure A – 4
PGW Supporting Financial Information

			2011	2012	2013	2014	2015
<u>Income Statement Items</u>							
[1]	Operating Revenues	(\$000)	766,279	644,983	693,471	759,136	697,247
[2]	Operating Expenses	(\$000)	641,640	550,338	574,011	640,943	606,526
[3]	Gas Operating Expenses	(\$000)	641,640	550,338	574,011	640,943	606,526
[4]	Purchased Gas/Power	(\$000)	330,932	233,713	255,501	304,051	252,169
[5]	Depreciation	(\$000)	38,915	40,175	41,042	41,657	43,787
[6]	Amortization	(\$000)	0	0	0	0	0
[7]	Operating Income	(\$000)	124,639	94,645	119,460	118,193	90,721
[8]	Interest	(\$000)	75,682	69,544	59,965	57,135	56,523
[9]	Taxes	(\$000)	25,135	25,122	25,220	25,687	25,823
[10]	Interest Income	(\$000)	4,348	4,659	1,147	3,597	3,784
[11]	Net Income	(\$000)	35,305	11,760	42,642	46,655	19,982
<u>Balance Sheet Items</u>							
[12]	Total Long-Term Debt	(\$000)	1,217,541	1,117,047	1,086,382	1,033,976	957,749
[13]	Total Short-Term Debt	(\$000)	0	0	0	0	30,000
[14]	Total Equity	(\$000)	309,740	315,945	358,587	258,002	277,984
[15]	Total Capitalization	(\$000)	1,527,281	1,432,992	1,444,969	1,291,978	1,265,733
[16]	Current Year Debt	(\$000)	1,217,541	1,117,047	1,086,382	1,033,976	987,749
[17]	Principal Paid on Long-Term Debt	(\$000)	40,459	97,608	27,720	49,800	50,975
[18]	2-Year Avg Total Debt	(\$000)	1,242,533	1,167,294	1,101,715	1,060,179	1,010,863
[19]	Cash & Equivalent Instruments	(\$000)	105,386	75,826	100,933	105,734	114,327
[20]	Net Plant	(\$000)	1,070,523	1,071,799	1,110,578	1,136,346	1,168,116
[21]	Gross Plant	(\$000)	1,856,303	1,894,129	1,951,546	2,018,234	2,093,112
<u>Misc</u>							
[22]	CapEx	(\$000)	58,825	54,746	70,380	80,222	82,606
[23]	Total Gas Volumes	(mcf)	71,632,367	64,953,588	73,229,988	79,044,219	NA

Sources:

PGW Comprehensive Annual Financial Report 2011, 2012, 2013, 2014, 2015.

FCG Figure A – 5
PGW Annual Metric Calculation

		2011	2012	2013	2014	2015	Average
[24]	Debt/Capitalization	80%	78%	75%	80%	78%	78%
[25]	Operating Margin	29%	23%	27%	26%	20%	25%
[26]	IGF/Revenues	38%	33%	37%	35%	30%	34%
[27]	FFO/CapEx	1.26	0.95	1.19	1.10	0.77	1.05
[28]	Days Cash (days)	64	54	69	64	74	65
[29]	FFO/Debt	0.06	0.04	0.08	0.08	0.06	0.07
[30]	FFO Coverage	1.98	1.75	2.40	2.55	2.13	2.16
[31]	EBIT Coverage	1.80	1.53	2.13	2.27	1.81	1.91
[32]	Interest-Only Debt Service Coverage	2.22	2.01	2.70	2.86	2.45	2.45
[33]	Debt Service Coverage (Principal & Interest)	1.45	0.83	1.84	1.53	1.29	1.39
[34]	CapEx/DA	151%	136%	171%	193%	189%	168%
[35]	Net Plant/Gross Plant	58%	57%	57%	56%	56%	57%
[36]	CapEx/Net Plant	5%	5%	6%	7%	7%	6%
[37]	Gas OpEx/Volume \$/mcf	4.34	4.87	4.35	4.26	NA	4.46

Notes:

- [24] = ([12] + [13]) / [15]
- [25] = [6] / ([1] - [4])
- [26] = ([7] + [5] + [6]) / ([1] - [4])
- [27] = ([11] + [5] + [6]) / [22]
- [28] = [19] / ([2] - [5] - [6])
- [29] = ([11] + [5] + [6]) / [18]
- [30] = ([11] + [5] + [6] + [8]) / [8]
- [31] = ([11] + [8] + [9]) / [8]
- [32] = ([7] + [5] + [6] + [10]) / [8]
- [33] = ([7] + [5] + [6] + [10]) / ([8] + [17])
- [34] = [22] / ([5] + [6])
- [35] = [20] / [21]
- [36] = [22] / [20]
- [37] = [3] / [23]

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

REBUTTAL TESTIMONY OF

FRANK C. GRAVES

ON BEHALF OF
PHILADELPHIA GAS WORKS

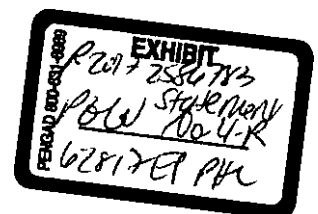
Docket No. R-2017-2586783

Philadelphia Gas Works

General Rate Increase Request

Topic Addressed:
Debt Service Coverage Ratios

June 9, 2017



1 **Q. PLEASE STATE YOUR NAME, POSITION, AND BUSINESS ADDRESS.**

2 A. My name is Frank C. Graves. I am a Principal at the economic consulting firm The
3 Brattle Group, where I am also the leader of the utility practice group. The Brattle
4 Group's Boston office is located at One Beacon Street in Boston, Massachusetts.

5 **Q. DID YOU PREVIOUSLY SUBMIT TESTIMONY IN THIS PROCEEDING ON**
6 **BEHALF OF PGW?**

7 A. Yes. I submitted my direct testimony, PGW St. No. 4 on February 27, 2017.

8 **Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?**

9 A. My rebuttal testimony responds to statements on the value of benchmarking and the
10 necessary debt service coverage ratios for PGW posed by Witness Maurer,
11 representing the Bureau of Investigation & Enforcement ("I&E"), and similar
12 concerns expressed by Witness Habr representing the Office of the Consumer
13 Advocate ("OCA").¹

14 **Q. WITNESSES HABR AND MAURER BOTH PROPOSE LOWER DEBT-**
15 **SERVICE COVERAGE RATIOS THAN PGW. HOW DO WITNESSES**
16 **HABR AND MAURER ARRIVE AT THESE COVERAGE RATIOS?**

17 A. I understand from Witness Habr's testimony that he arrives at the proposed debt
18 service coverage ratio ("DSCR") of 1.85x by averaging the 5-year historical and 10-
19 year historical aggregate DSCRs.² Witness Habr indicated that he averaged the 5-
20 year and 10-year historical DSCRs in order to give more weight to improved
21 operations over the most recent 5 years while also including PGW's weaker
22 performance in earlier years. The 1.85x DSCR proposed by Witness Habr is lower
23 than the Company's target, in part because he also believes that recent sharp increases

¹ I&E Statement No. 1, Witness Maurer (amended) pp.16-19; OCA Statement No. 2, Witness Habr pp. 7-9.

² OCA Statement No. 2, Witness Habr pp.7-8.

1 in PGW's debt ratio due to GASB 75 and OPEB accounting liability recognition
2 should be reversed more slowly than the Company's proposal. He does not offer a
3 basis for his recommendation grounded in the operating or financial risks of the
4 Company, just his sense that the historical average is adequate.

5 As I understand Witness Maurer's testimony, her proposed DSCR of 1.82x is
6 the result of proposed adjustments to fully projected future test year ("FPFTY")
7 revenues and an assumption of the benefits and feasibility of increased debt financing
8 by PGW in that year, resulting in a smaller rate increase being proposed (at \$33.8
9 million instead of \$70 million proposed by the Company).³ Her view is that PGW
10 can sustain a debt ratio closer to 70% and still have several metrics monitored by
11 ratings agencies in a range that would support as good or better a rating than the
12 Company now has. Witness Maurer states that a DSCR of 1.82x provides adequate
13 cash flow (revenue requirements) to fund debt reliably along with PGW's operating
14 expenses and other obligations.⁴ However, her analysis and conclusions are based
15 only on the single FPFTY, with no consideration of the longer term consequences for
16 additional debt financing and the resulting reductions in coverage and cash on hand.
17 Even though she believes the 2017 metrics would be adequate for a sustained rating
18 in the FPFTY, it surely would occur to ratings agencies that her proposal causes
19 longer term attrition in the financial health of the Company.

20 **Q. WOULD THE LOWER DSCR LEVELS PROPOSED PROVIDE A**
21 **SUFFICIENT MARGIN TO AVOID VIOLATING PGW'S COVENANTS**
22 **BASED ON HISTORICAL ANALYSIS?**

³ I&E Statement No. 1, Witness Maurer (amended) p. 17.

⁴ I&E Statement No. 1, Witness Maurer (amended) p. 19, lines 1-2.

1 A. Except perhaps for extremely high coverage ratios, there is no practical level that can
2 assure covenants will never be violated. However, the tighter the coverage ratios
3 become, the more one relies increasingly on good fortune rather than prudent
4 financial management to stay viable or avoid financial constraints. Historically,
5 PGW's aggregate debt service coverage ratios have varied year-to-year and in one
6 case by more than 0.6x between consecutive years. Such swings can occur for a
7 variety of uncontrollable reasons related to weather, unforeseen engineering
8 problems, economic downturns and the like, and so they are likely to reoccur in the
9 future. To avoid violation of covenant requirements, PGW's DSCR under anticipated
10 or "normal" operations need to be determined in such a way to provide an adequate
11 financial cushion in case of lower than anticipated net revenues.

12 This extent of annual coverage variation from the anticipated or "normal"
13 conditions occurred for PGW between the 2010-11 and 2011-12 operating years. The
14 2010-11 heating season experienced approximately 30-year normal weather and
15 associated gas demand, and PGW had an aggregate DSCR in that year of 1.77x. By
16 contrast, the 2011-12 heating season was significantly warmer than the 30-year
17 weather normal, causing much less winter volume than had been expected or than
18 was needed for preferred cost recovery margins.⁵ The decreased revenue, even
19 though it includes funds recovered through the weather normalization adjustment, had
20 a substantial impact on the aggregate debt service coverage ratio, which fell to 1.51x.
21 This is only marginally above the covenant- required DSCR of 1.50x. If PGW's

⁵ While mitigating some effects of warmer weather on PGW's revenues, the weather normalization adjustment does not protect the company from the full effects of warmer weather, and PGW's revenues can be shown to vary in concert with the weather during the heating season.

1 anticipated DSCR was 1.82x going forward, as recommended by Witness Maurer,
2 and PGW experienced a similarly warm winter, it may be at risk of skirting covenant
3 requirements of a 1.50x DSCR.

4 If this kind of warm weather were to also coincide with other adverse
5 conditions, such as a recession or an adverse operating cost, a deeper dip towards or
6 below covenant requirements might occur.

7 **Q. WHAT ARE YOUR CONCLUSIONS FROM YOUR BENCHMARKING**
8 **REGARDING THE DEBT SERVICE COVERAGE RATIO OF**
9 **APPROXIMATELY 1.83X RECOMMENDED BY OCA AND I&E?**

10 A. In my direct testimony at FCG-25 I show that PGW has historically had the lowest or
11 near-lowest interest-only DSCR within the municipal benchmarking group over the
12 2011-2015 time period. In particular, in 2015 PGW had the lowest interest-only
13 DSCR of its municipal peers, when its interest-only DSCR was calculated to be
14 2.45x, following the generic formula used in my benchmarking, while its municipal
15 peers ranged from 2.97x to 4.61x. As noted in my direct testimony, the generic
16 formula I applied was developed to compare utilities on an apples-to-apples basis, in
17 the fashion that an outside investor considering the health of PGW vs. other lending
18 investments could also apply. It does not correspond directly to PGW's calculated
19 DSCR (interest and principal), but it reflects the trends and relative position. In this
20 same year, 2015, PGW's aggregated DSCR (interest and principal) was 1.83x.
21 Assuming that PGW's municipal peers maintain their 2015 coverage values into the
22 future, an aggregate DSCR (interest and principal) of 1.83x for PGW would likely
23 continue to place it at the low-end of the municipal peer group.

24 This matters because both absolute and relative levels of financial metrics are
25 relevant to investors. A hard boundary like a debt covenant must be respected, but

even when this is done (especially if barely so) the degree of comfort investors have in one company versus another also affects access to capital. Both witnesses Maurer and Habr focus predominantly on absolute levels for the metrics they are seeking to tune, with a view to making those as slim as would be sufficient for good ratings if market conditions turn out about like the FPFTY assumptions. This puts relatively little weight on comparative metrics, which as pointed out above, have been and will remain lower than municipal peers if the intervener suggestions are applied. As a general rule, similar companies that provide relatively lower risk to investors will have lower interest rates on financing or priority in a recession (when willingness to lend can sometimes dry up). Reliable access to capital then creates a virtuous circle of assurance that a company can perform customer service, maintenance and system-enhancement projects on schedule with high quality and without interruption or setbacks. If financial margins are stressed, something has to give in that mix of benefits.

Q. ARE CUSTOMERS OF MUNICIPAL UTILITIES IMPACTED DIFFERENTLY THAN INVESTOR-OWNED UTILITY CUSTOMERS WHEN RATES ARE INCREASED?

A. Yes, as a municipal utility, PGW's financing costs and its "earnings" (e.g. from coverage margins in excess of out of pocket debt service costs) are ultimately borne entirely by its customers. Savings in financing costs will result in lower customer bills, and increases in these costs will translate to higher costs to customers. There is no equity investor pool that gains/losses from a higher/lower interest coverage level as changes in income for distribution. Any "excess" coverage to the municipal utility that provides risk protection in the near term is always subsequently returned to customers as reduced financing at better rates, or as earlier achievement of system

1 improvements that provide their own benefits of safety and product quality. In
2 essence, PGW's customers are its virtual equity holders.

3 **Q. DOES THIS CONCLUDE YOUR REBUTTAL TESTIMONY?**

4 **A. Yes.**

**BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION**


Pennsylvania Public Utility Commission	:	R-2017-2586783
Office of Consumer Advocate	:	C-2017-2592092
Office of Small Business Advocate	:	C-2017-2593497
Philadelphia Industrial & Commercial	:	
Gas Users Group	:	C-2017-2595147
William Dingfelder	:	C-2017-2593903
	:	
v.	:	
	:	
Philadelphia Gas Works	:	

VERIFIED STATEMENT

I, Frank C. Graves, hereby state that the facts set forth below are true and correct to the best of my knowledge, information and belief and I understand that the statements herein are made subject to the penalties of 18 Pa. C.S. § 4904 (relating to unsworn falsification to authorities).

1. I have submitted testimony in this proceeding on behalf of Philadelphia Gas Works and am authorized to make this statement on its behalf.
2. I prepared PGW St. No. 4 which includes Appendix 1 and Appendix 2 and was served on the parties in this proceeding on February 27, 2017.
3. I prepared PGW St. No. 4-R which was served on the parties in this proceeding on June 9, 2017.
4. I do not have any corrections to any of this testimony.
5. If I were asked the same questions set forth in each of these statements today, my answers would be the same.

Date: June 26, 2017


Frank C. Graves