DE 11-250
Public Service Company of New Hampshire
Investigation of Scrubber Costs & Cost Recovery
OCA's Responses to the Commission Staff Data Requests – Set #1

Date Received: January 16, 2014 **Date of Response: February 7, 2014**
Request No.: Staff 1-3 **Witness: Matthew Kahal**

Request: Reference page 6, lines 7-8. You state, "By late 2008 and early 2009, the changes were becoming increasingly obvious to professionals in the energy and electric utility industry." Please provide copies of all forecasts, publications and other documents that support your statement.

Response: During this time period, there were numerous articles in the energy industry trade press discussing the impending expansion of gas supply from "unconventional gas," i.e., gas produced by hydraulic fracturing technologies. This is discussed in the U.S. Department of Energy's Annual Energy Outlook 2009 (DOE/EIA-0383(2009)), dated March 2009. This is available on the DOE website. Attached to this response is the summary from the Potential Gas Committee report, which was an exhibit in the Entergy Louisiana docket discussed in Mr. Kahal's testimony (Exhibit APW-3, LPSC Docket No. U-30192, Phase III).

In the docket, Entergy Louisiana consulted forecasts from several major forecasting organizations in reaching its conclusion that the long-term outlook for natural gas prices as of early 2009 was far below the Summer 2008 outlook. In particular, based on its review of these proprietary forecasts, the Company reduced its long-term gas price forecast from $9.24 per MMBtu in July 2008 to $7.79 per MMBtu in February 2009—8 months later—a 16 percent price reduction. (These figures are levelized values, 2012-2041, 2007 dollars.) Entergy also noted (based on information supplied by the consulting firm PIRA) that U.S. shale gas production had been increasing dramatically in recent years, from about 1 BCF per day in 2001 to over 6 BCF per day in 2008. This reflects fundamental and dramatic market trends, not short term market fluctuations.

The most important and obvious information pertains to actual natural gas prices and, in particular, the published natural gas futures prices. Spot natural gas prices declined from more than $13 per MMBtu in Summer 2008 to less than $4 per MMBtu during early 2009. The table below shows the NYMEX forward prices (Henry Hub, $ per MMBtu) for a ten-year period, 2010 to 2019 at various points in time during mid-2008 to early-2009.

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NYMEX Forward Gas Prices
(Henry Hub, $/MMBtu)

Year	7/1/08	10/1/08	1/2/09	4/1/09
2010	$11.33	$8.71	$7.33	$5.85
2011	10.83	8.66	7.48	6.62
2012	10.71	8.52	7.39	6.94
2013	10.89	8.41	7.30	7.10
2014	11.11	8.40	7.30	7.17
2015	11.36	8.54	7.36	7.24
2016	11.60	8.70	7.45	7.32
2017	11:84	8.86	7.56	7.42
2018	12.10	9.02	7.71	7.53
2019	12.37	9.17	7.86	7.63
Average	$11.42	$8.70	$7.47	$7.08

As this table demonstrates, the NYMEX ten-year forward gas prices (2010-2019) declined from about $11.42 as of July 2008 to about $7.08 as of April 2009. This is a $4 per MMBtu or 38 percent reduction in the long-run average outlook for natural gas prices that took place over a period of only nine months. The NYMEX forward gas prices are publically available on a daily basis and are closely followed by the energy professionals. This information was readily available to PSNH planning staff in 2008/2009 and was a clear indication that dramatic changes were taking place at that time in the gas industry.

Potential Gas Committee

For Release June 18, 2009, 1100 EDT

Contact: Dr. John B. Curtis, Potential Gas Agency, Colorado School of Mines, Golden, CO 80401-1887. Telephone 303-273-3886; fax 303-273-3574; ldepagni@mines.edu.

POTENTIAL GAS COMMITTEE REPORTS UNPRECEDENTED INCREASE IN MAGNITUDE OF U.S. NATURAL GAS RESOURCE BASE

GOLDEN, COLORADO — The Potential Gas Committee (PGC) today released the results of its latest biennial assessment of the nation's natural gas resources, which indicates that the United States possesses a total resource base of 1,836 trillion cubic feet (Tcf). This is the highest resource evaluation in the Committee's 44-year history. Most of the increase from the previous assessment arose from reevaluation of shale-gas plays in the Appalachian basin and in the Mid-Continent, Gulf Coast and Rocky Mountain areas.

"The PGC's year-end 2008 assessment reaffirms the Committee's conviction that abundant, recoverable natural gas resources exist within our borders, both onshore and offshore, in all types of reservoirs," said Dr. John B. Curtis, Professor of Geology and Geological Engineering at the Colorado School of Mines and Director of the Potential Gas Agency there, which provides guidance and technical assistance to the Potential Gas Committee.

Dr. Curtis cautioned, however, that the current assessment assumes neither a time schedule nor a specific market price for the discovery and production of future gas supply. "Estimates of the Potential Gas Committee are 'base-line estimates' in that they attempt to provide a reasonable appraisal of what we consider to be the 'technically recoverable' gas resource potential of the United States," he explained.

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The Committee's year-end 2008 assessment of 1,836 Tcf (statistically aggregated mean value) consists of 1,673 Tcf of gas attributable to traditional reservoirs and 163 Tcf in coalbed reservoirs. Compared to year-end 2006, traditional resources increased by nearly 519 Tcf (45%), while coalbed gas resources decreased by 3 Tcf (1.9%), resulting in a net increase in total potential resources of 515 Tcf (39%). (See accompanying Table 1.)

These changes have been assessed in addition to the 41 Tcf of marketed domestic natural gas production recorded during the two-year period since the Committee's previous report.

When the PGC's results are combined with the U.S. Department of Energy's latest available determination of proved gas reserves, 238 Tcf as of year-end 2007, the United States has a total available *future supply* of 2,074 Tcf, an increase of 542 Tcf over the previous evaluation.

As Dr. Curtis observed, "Our knowledge of the geological endowment of technically recoverable gas continues to improve with each assessment. Furthermore, new and advanced exploration, well drilling and completion technologies are allowing us increasingly better access to domestic gas resources—especially 'unconventional' gas—which, not all that long ago, were considered impractical or uneconomical to pursue."

"Consequently, our present assessment demonstrates an exceptionally strong and optimistic gas supply picture for the nation."

Overall, the Gulf Coast, including the Gulf of Mexico continental shelf, slope and deepwater, remains the country's richest resource area, followed by the Rocky Mountain, Atlantic and Mid-Continent regions, which together account for 87% of the 2008 assessed traditional resource. (See accompanying Table 2.) Changes in the assessments from 2006 to 2008 arose primarily from analyses of new geological, drilling, well-test and production data from these same four regions. The largest volumetric and percentage increases resulted from reassessments of active and newly developing shale-gas plays in the Appalachian basin of the Atlantic area, the Arkoma and Fort Worth basins of the Mid-Continent area, several basins of the Gulf Coast area, and the Uinta basin of the Rocky Mountain area.

The growing importance of shale gas is substantiated by the fact that, of the 1,836 Tcf of total potential resources, shale gas accounts for 616 Tcf (33%). The number of plays, the level of production and the magnitude of perceived in-place resources have increased to the point that PGC, for the first time, is publishing a separate tabulation of its ongoing province- and area-level shale-gas assessments.

Also this year, for the first time, PGC is issuing an *Advance Summary* of its assessment results. This document will provide purchasers who preorder the Committee's printed report with all of the national, area- and province-level assessment tabulations and accompanying graphical representations for immediate analysis and critique.

PGC's 2008 report includes detailed area- and province-level resource assessments, summaries of recent E&P activities, and updated editions of its popular value-added features:

- *PGC and the Ultimately Recoverable Resource*—explains in simplified terms, with annotated graphics, the time-dynamic nature of gas resource assessment, the relationship between proved reserves and the PGC's categories of resources, and how these quantities lead to determination of the ultimately recoverable gas resource.
- *Historical Trends I*—Annual trends in crude oil, natural gas and gas liquids production for 1980-2008, together with the basics of 'vintaged' production graphs, production profiles, well and rig statistics, prices, revenues and other useful parameters, as well as forecasts of production trends to 2030. Accompanying text describes each plotted trend, which is keyed to a graphical folio for the U.S. containing more than 90 charts that are rarely, if at all, seen in print elsewhere. (Similar folios for all producing regions and provinces are available on a separate CD-ROM.)
- *Historical Trends II*—Monthly gas production and well-count histories for all Lower 48 States' onshore and offshore provinces, allowing the reader to compare and contrast basins with rising, falling or stable production trends.
- *Historical Trends III*—Gas-well permitting and spudding histories for all producing provinces, a measure of overall health of the industry from basin to basin.
- *Historical Trends IV*—"Top-ten" rankings of gas producers and well production trends and performance, arranged by PGC province.
- *North American Perspectives I-II*—overviews of natural gas resources, production and recent E&P activities in Canada and Mexico.
- *Frontier Gas Resources I-IV*—latest domestic and international developments in natural gas hydrates and liquefied natural gas (LNG); deep drilling for natural gas in the U.S.; and U.S. shale gas resources and play characteristics.
- *Comparison of Assessments*—a look at how PGC assesses gas resources and how the Committee's assessment methodology and latest results contrast with those of other organizations.
- *From Reservoir to Burner Tip*—PGC's natural gas "primer," a less technical discussion of how and where natural gas occurs and how it is produced, stored, transported, delivered to and beneficially used by consumers.

In addition to the Advance Summary and full printed report, the PGC will release the third edition of its information-packed CD-ROM product, *PGC Trove 2009*. This disc will include digital versions of the report, both in its entirety and as amply bookmarked individual chapters. The trove will again feature the comprehensive *Folio of Historical Production Trends and Forecast for the United States*, consisting of more than 2,500 historical-trend plots covering the entire U.S., the Lower 48 States, each oil- and gas-producing region and each onshore and offshore producing province. PGC also will premier a suite of spreadsheets that tabulate all of the Committee's published national, area- and province-level assessment results back to 1964.

With these three offerings, the Potential Gas Committee presents a more complete picture of present gas supply and productive capacity of the North American natural gas industry than it has compiled previously.

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Details of the Potential Gas Committee's Natural Gas Resource Assessment

(as of December 31, 2008)

The Potential Gas Committee (PGC) reports its gas resource assessments biennially in three categories of decreasing certainty—*Probable*, *Possible* and *Speculative*. For each category, a *minimum*, *most likely* and *maximum* volume is assessed for each of 89 geological provinces in the Lower 48 States and Alaska. The *mean* values shown in Table 1 below were calculated by statistical aggregation of the minimum, most likely and maximum traditional values for each resource category. Mean values for total traditional resources and total coalbed gas resources are aggregated separately. This procedure imparts greater statistical validity to the results and allows for more direct comparison of PGC's assessments with those made by other organizations.

Table 1.

	(Mean Values, Tcf)		Change
Resources Category	2008	2006	Tcf (%)
Traditional Gas Resources:			
Probable resources (current fields)	441.4	270.1	
Possible resources (new fields)	736.9	426.4	
Speculative resources (frontier)	500.7	460.7	
Subtotal Traditional Resources*	1,673.4	1,154.8	+518.6 (44.9%)
Coalbed Natural Gas:			
Probable resources	14.2	15.5	
Possible resources	49.8	50.9	
Speculative resources	98.9	98.9	
Subtotal Coalbed Gas Resources*	163.0	166.1	–3.1 (1.9%)
Total Potential Resources	**1,836.4**	**1,320.9**	+515.5 (39.0%)
Proved reserves (DOE/EIA)	237.7**	211.1	
U.S. Future Supply	**2,074.1**	**1,532.0**	+542.1 (35.4%)

* Mean values for Probable, Possible and Speculative resources are *not* arithmetically additive in deriving the subtotal. Subtotal mean values *are* additive in deriving Total Potential Resources.

** Latest available figure is for year-end 2007.

Note: Totals are subject to rounding and differences due to statistical aggregation of distributions.

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PGC's 89 geological provinces are grouped into seven geographic areas. In similar fashion as above, the minimum, most likely and maximum values for each category of traditional resources in each province within an area are aggregated at the area level to yield mean values for area Probable, Possible and Speculative traditional resources and a separately aggregated area total. Coalbed gas resources are not aggregated at the area level. Table 2 below compares the total mean values for these areas for years-end 2008 and 2006.

Table 2.

	(Mean Values, Tcf)		Change
Producing Area	2008	2006	Tcf (%)
Gulf Coast (including Gulf of Mexico)	455.2	329.6	+125.6 (38.1%)
Rocky Mountain	374.4	233.6	+140.9 (60.3%)
Atlantic	353.5	91.7	+261.8 (285%)
Mid-Continent	274.9	232.2	+42.7 (18.4%)
Alaska	193.8	193.8	0 (0%)
Pacific	51.3	55.5	–4.2 (7.6%)
North Central	24.0	22.0	+2.0 (8.9%)
Total U.S. Traditional Resources*	1,673.4	1,154.8	+518.6 (44.9%)
Coalbed Natural Gas (all areas combined)	163.0	166.1	–3.1 (1.9%)
Total Potential Resources	**1,836.4**	**1,320.9**	+515.5 (39.0%)
Proved reserves (DOE/EIA)	237.7**	211.1	
U.S. Future Gas Supply	**2,074.1**	**1,532.0**	+542.1 (35.4%)

* Mean values of total resources for the seven areas are *not* arithmetically additive in deriving Total U.S. Traditional Resources.
** Latest available figure is for year-end 2007.
Note: Totals are subject to rounding and differences due to statistical aggregation of distributions.

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How to Obtain the Potential Gas Committee Report

Prepublication orders for the full printed PGC report, *Potential Supply of Natural Gas in the United States (December 31, 2008)* may now be placed with the Potential Gas Agency, Colorado School of Mines, Golden, CO 80401-1887. The cost of the printed report is US$495 (US$515 for foreign shipment), if payment accompanies the order. The printed report with the companion CD-ROM will be available for US$950 (US$970 for foreign shipment). All purchasers will receive the *Advance Summary* immediately and will automatically be sent the full printed report (or report plus CD-ROM) when the book is expected to become available in late summer.

For additional information about ordering these and previous reports and CDs, please contact Linda D'Epagnier, Program Assistant, at the Potential Gas Agency, telephone 303-273-3886, fax 303-273-3574, or e-mail: ldepagni@mines.edu.

About the Potential Gas Committee

The Potential Gas Committee, an incorporated, nonprofit organization, consists of knowledgeable and highly experienced volunteer members who work in the natural gas exploration, production and transportation industries and in the field and technical services and consulting sectors. The Committee also benefits from the input of respected technical advisors and various observers from federal and state government agencies, academia, and industry and research organizations in both the United States and Canada. Although the PGC functions independently, the Potential Gas Agency at the Colorado School of Mines provides the Committee with guidance, technical assistance, training and administrative support, and assists in member recruitment and outreach. The Potential Gas Agency receives financial support from prominent E&P and gas pipeline companies and distributors, as well as industry trade and research organizations and unaffiliated individuals.

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