ESTIMATED ENERGY MARKET SAVINGS FROM ADDITIONAL PIPELINE INFRASTRUCTURE SERVING EASTERN PENNSYLVANIA AND NEW JERSEY:

UPDATE FOR WINTER 2017/2018

PREPARED FOR:

PENNEAST PIPELINE COMPANY, LLC

APRIL 2018

PREPARED BY:

CONCENTRIC ENERGY ADVISORS

WWW.CEADVISORS.COM

Concentric Energy Advisors is a management consulting and financial advisory firm focused on the North American energy industry. Our firm was founded in 2002 by a small group of executive-level consultants committed to establishing a mid-sized energy consulting firm with capabilities and a reputation unsurpassed by any firm in North America. Since its inception, Concentric has grown more than eight-fold and has significantly expanded its service offerings, while remaining focused on achieving the highest standards of consulting excellence in the energy field.

The expertise of our staff spans all aspects of the natural gas, power, and oil markets. We offer a broad range of advisory and support services that enable our clients to address diverse needs comprehensively without the difficulty of retaining and coordinating multiple resources. Through our subsidiaries, CE Capital Advisors, Concentric Advisors ULC, and Concentric Energy Publications, we provide capital market advisory support, consulting services in Canada, and publish The Foster Report, respectively.

Concentric's experts have performed numerous strategic natural gas market assessments throughout North America for pipelines, producers, natural gas storage providers, LNG developers, and lenders. These assessments have evaluated historical and future markets for energy assets, and have considered aspects including risk assessments, comparative cost assessments, valuations, quantifications of savings associated with new infrastructure, and regulatory environment and policy assessments.

DISCLAIMER

Concentric Energy Advisors, Inc. provides information and projections consistent with standard practices. The analyses contained herein require certain assumptions; however, it is the opinion of Concentric that these assumptions and the corresponding results reflected herein are reasonable. All analyses are based on the best information available at the time they were conducted. Concentric makes no warranty or guarantee regarding the accuracy of any forecasts, estimates, or analyses, or that such work products will be accepted by any legal or regulatory body.

TABLE OF CONTENTS

SECTION 1:
INTRODUCTION

A. OVERVIEW

Concentric Energy Advisors, Inc. ("Concentric") has been retained by PennEast Pipeline Company, LLC ("PennEast") to update the independent estimate of potential savings to energy market participants in eastern Pennsylvania and New Jersey associated with the PennEast Pipeline project that Concentric originally conducted in March 2015 ("Original Report"). In the Original Report, Concentric focused on four primary areas of potential savings associated with additional pipeline infrastructure and lower market area natural gas prices:

- Savings that could be achieved by electric consumers when natural gas-fired generation resources set the electric energy price based on lower market area natural gas prices ("Gas-Fired Generation Savings")
- Savings that could be achieved by electric consumers when natural gas-fired generation resources could displace less efficient and more costly oil-fired generating resources, and set the electric energy price based on lower market area natural gas prices ("Oil-Fired Generation Displacement Savings")
- Savings that could be achieved by industrial natural gas consumers that are purchasing natural gas supplies at lower market area natural gas prices ("Industrial Transport Customer Savings")
- Savings that could be achieved by LDC customers when LDCs have the opportunity to purchase more natural gas supplies from lower-cost, local Marcellus Shale production as opposed to often higher-cost Gulf Coast production ("LDC Gas Supply Savings")

Due to the high natural gas prices experienced this winter in the areas to be served by the pipeline, PennEast has asked that Concentric update the Original Report.

B. EXECUTIVE SUMMARY

The primary conclusions from Concentric's analysis are as follows:

- It is generally accepted that natural gas markets that are constrained during some or all of the year, and thus reflect higher and more volatile natural gas pricing during such periods, can benefit from additional pipeline capacity to mitigate the higher and more volatile pricing.
- The Original Report evaluated the winter of 2013/2014, which experienced relatively severe and prolonged cold, and resulted in high levels of demand for natural gas from local natural gas distribution companies, industrial customers and electric generators, and extremely volatile pricing and significantly higher natural gas prices in the U.S. Northeast than had ever been previously experienced.
- Similar cold weather, high levels of natural gas demand and high and volatile natural gas and electric prices were experienced again this winter (*i.e.*, 2017/2018). Because natural

gas demand is expected to grow, similar weather conditions can continue to produce similar or higher natural gas and electric prices in the future, unless additional infrastructure is built to alleviate constraints.

- Additional natural gas pipeline capacity, such as proposed by PennEast, has the potential to provide significant value to energy consumers in eastern Pennsylvania and New Jersey by lowering natural gas prices during high price periods.
- Concentric utilized the same framework and analysis as previously conducted in the Original Report, and simply updated the estimated savings for natural gas consumers that could have otherwise been achieved with an additional 1 Bcf/d of pipeline capacity based on data available for the winter of 2017/2018.
- To quantify the magnitude of the benefits that PennEast could provide to natural gas consumers, Concentric estimated what natural gas prices could have otherwise been in the winter of 2017/2018 if an additional 1 Bcf/day of pipeline capacity had been available by evaluating the relationship between natural gas prices that actually occurred in eastern Pennsylvania and New Jersey relative to the natural gas demand experienced in the region on each day.[1]
- Based on its analysis, and as summarized in Table 1, Concentric estimates that energy consumers in eastern Pennsylvania and New Jersey could have saved an additional $435 million in the winter of 2017/2018, had an additional 1 Bcf/d of pipeline capacity been available.

Table 1:
Estimated Savings if an Additional 1 Bcf/d of Pipeline Capacity Had Been Available for the Winter of 2017/2018

(All figures in $Millions)	Eastern Pennsylvania	New Jersey	Total
Electric Market Savings			
Gas-Fired Generation	$ 138	$ 100	$ 238
Oil-Fired Generation Displacement	$ 5	$ 3	$ 8
Subtotal	$ 143	$ 104	$ 246
Gas Market Savings			
LDC Gas Supply Procurement	$ 15	$ 30	$ 45
Industrial Transportation Customer	$ 106	$ 37	$ 144
Subtotal	$ 121	$ 67	$ 189
Total Estimated Savings:	**$ 264**	**$ 171**	**$ 435**

- Thus, consumers in eastern Pennsylvania and New Jersey could have potentially saved approximately $435 million dollars in the winter of 2017/2018, which is in addition to

[1] Concentric relied on publicly-available pricing, demand, and weather data for the natural gas and electric markets for its analysis. All other factors were held constant, including weather, operational issues, and the availability of natural gas and electric infrastructure.

the estimated energy market savings of $890 million that could have been achieved in the winter of 2013/2014 previously evaluated in the Original Report.

- Just as in the Original Report, the estimated savings figures reflected in Table 1 conservatively exclude potential savings that may have been achieved in the electric market on “extreme peak days” in which temperatures were coldest and natural gas demand was highest, and thus natural gas prices were also highest.

SECTION 2:
MARKET OVERVIEW

As discussed in the Original Report, LDCs purchase natural gas in production area supply basins (*e.g*., Gulf Coast; Marcellus), transport it over natural gas pipelines, and then deliver it to end-use customers over the local distribution system. Accordingly, LDCs typically have a number of natural gas supply contracts as well as various firm transportation contracts for capacity on pipelines, and they pass on the costs of these contracts to the customers for which they purchase natural gas supplies. Certain customers (typically very large customers, *e.g*., industrials and electric generators) do not purchase their natural gas from the LDC, instead they buy their natural gas from a third-party marketer at a mutually agreeable price, usually tied to local market area natural gas prices. Regardless of the price paid, natural gas generally must travel from production area supply basins to the market area through the interstate pipeline system.

There are generally two primary categories of natural gas pricing points: production area pricing points and market area pricing points. Production area pricing points represent the price of the natural gas commodity in a region in which there is significant natural gas production, (*i.e*., the wellhead, or the aggregation of production from different areas). Relevant production area price points for eastern Pennsylvania and New Jersey include Henry Hub, a major trading point in Louisiana that serves as a nation-wide benchmark price for natural gas, and more recently prices in the Marcellus Shale production area, including the Transco Leidy Line ("Transco Leidy") index, which represents the price of natural gas receipts onto Transco in northeastern Pennsylvania.

Market area pricing points represent the price of the natural gas commodity in the area in which it will be consumed, and reflects not only the cost of the commodity itself, but also the cost of transportation and other value drivers based on circumstances in that particular market. Relevant market area pricing points for eastern Pennsylvania and New Jersey include the Transco Zone 6 Non-New York ("TZ6NNY") index price.[2]

A "basis differential" is the difference between the price of natural gas at two pricing points at a given point in time (*e.g*., the difference between the Transco Leidy and TZ6NNY prices. Basis differentials reflect the value (but not necessarily the cost) of transportation between two pricing points at a particular time. To the extent that the basis differential between two points is substantially higher than the cost of transportation between those same two points, and that differential is sustained over a reasonably long period, this is an indication that there are pipeline constraints between those points, and provides a signal to pipeline project developers that there may be sufficient demand to contractually support the construction of new pipeline capacity to alleviate those constraints.

---

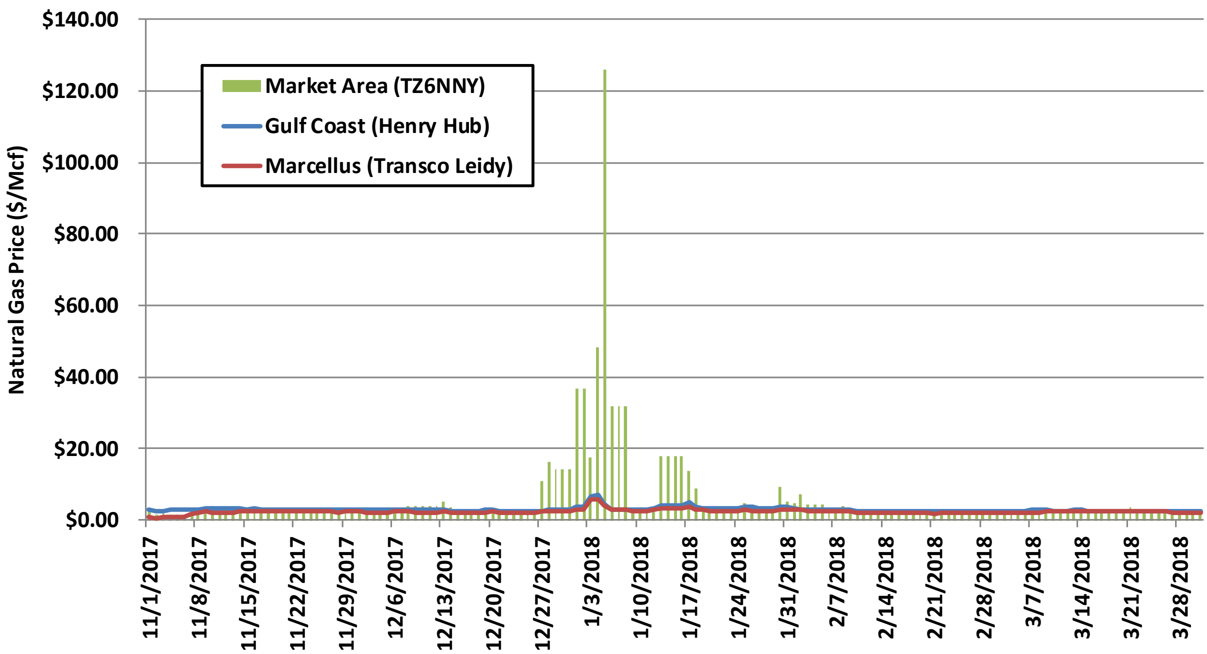
2 Since the Original Report, the Transco Zone 6 Non-New York ("TZ6NNYNorth") price has become more heavily traded and was used in the current analysis; however, the TZ6NNYNorth price is effectively the same as the TZ6NNY price (i.e., 90% of the time in the winter of 2017/2018 the prices were identical, and on days when they were not identical, they were within $0.02/Mcf of each other).

WINTER 2017/2018

It has been well documented that the winter of 2013/2014, with its relatively severe and prolonged cold, and resulting high levels of demand for natural gas from local natural gas distribution companies, industrial customers and electric generators, resulted in extremely volatile pricing and significantly higher natural gas prices in the U.S. Northeast than had ever been previously experienced despite certain new infrastructure projects being added to the region. It is important to note that while the weather was colder than previous winters, the weather did not reach peak design day conditions for which LDCs typically plan.

Severe winter weather, and resulting high natural gas prices, occurred again in the winter of 2017/2018. Figure 1 illustrates the relationship between production area prices (represented by Henry Hub and the Transco Leidy index prices) versus the market area prices (represented by the TZ6NNY index price) for the winter of 2017/2018.

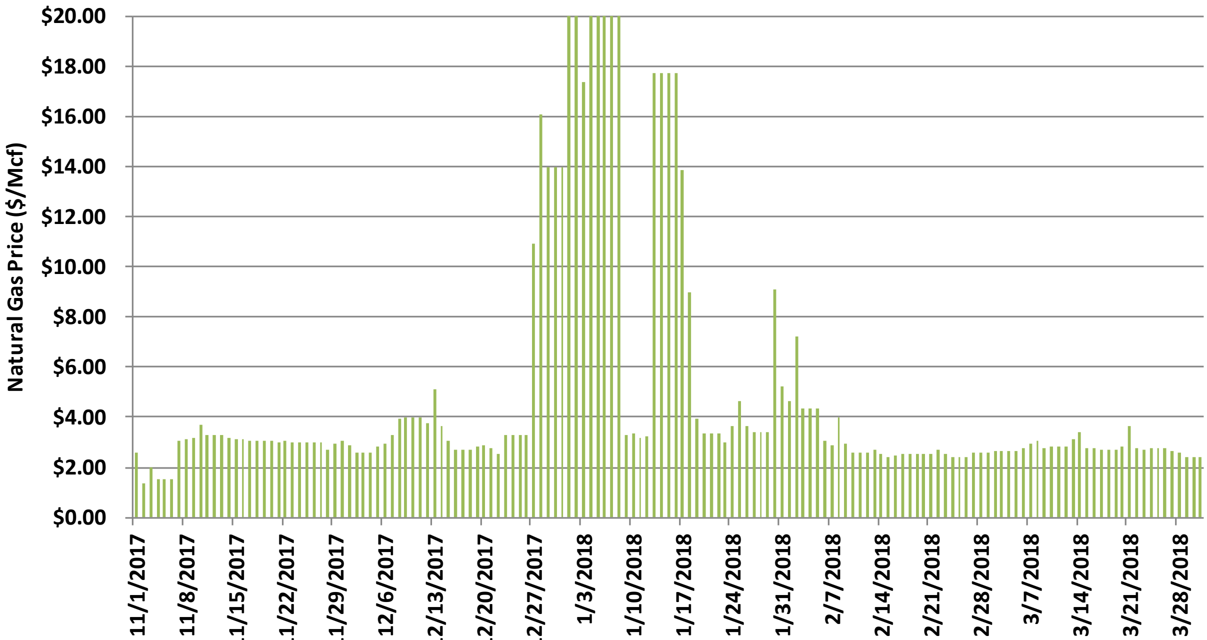
Figure 1:
Daily Spot Natural Gas Prices – Winter 2017/2018



As shown in Figure 1, the TZ6NNY prices reached over $120/Mcf in early January 2018, and as shown in the detailed graph in Figure 2, the TZ6NNY price exceeded $20/Mcf on 7 days during the winter of 2017/2018.[3]

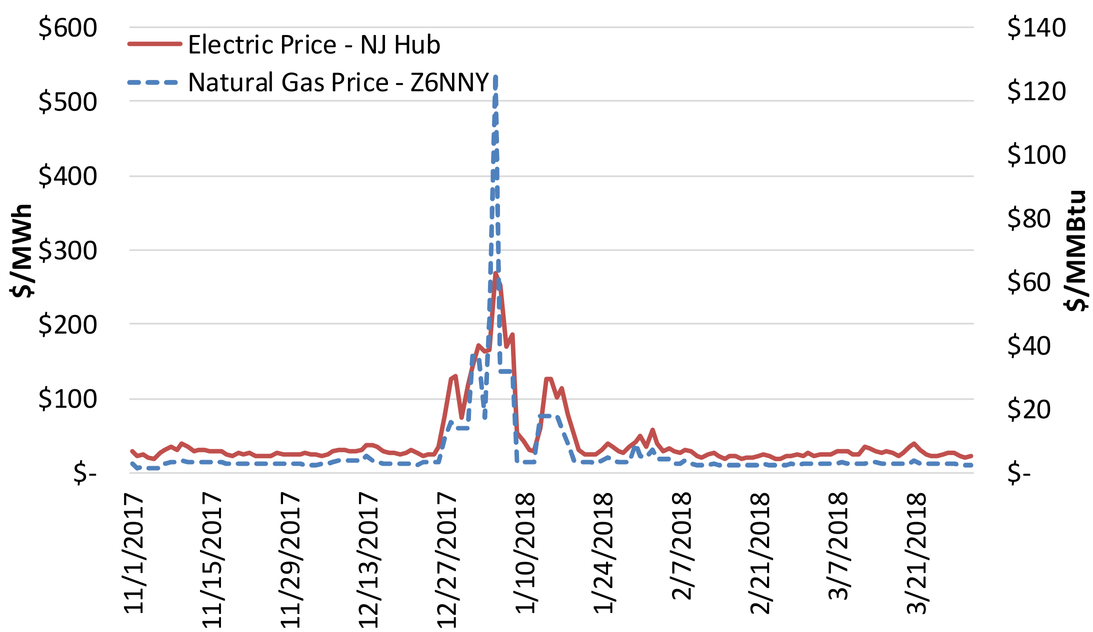
3 Daily spot midpoint prices as reported by Platts Gas Daily/Intercontinental Exchange, Inc.

Figure 2:
TZ6NNY Natural Gas Prices (Truncated at $20) – Winter 2017/2018



The higher natural gas prices experienced in the winter of 2017/2018 have caused a substantial increase in energy costs for natural gas consumers purchasing their supplies in the market area. In addition, due to the nature of the electric markets, wherein generators bids are significantly affected by their fuel cost, the price of natural gas significantly affected the price of electricity. For example, Figure 3 illustrates the impact to electric prices in New Jersey associated with high natural gas prices.

Figure 3:
Winter 2017/2018 Electric and Natural Gas Prices



There are a number of reasons for the spikes in spot natural gas prices that were experienced last winter in major demand centers along the east coast, which include: (i) colder than normal weather that increased peak demands; (ii) reductions in the availability of natural gas supply and pipeline transportation attributable to these weather conditions; (iii) lower than average storage inventories; and (iv) increased reliance on natural gas for power generation in competitive wholesale electric markets.[4] LDCs plan for "design" conditions that represent significantly colder than normal weather to ensure reliable service to its customers even during cold weather events. While the Polar Vortex winter of 2013/2014 and this winter of 2017/2018 both experienced very cold weather, neither reached extreme levels or surpassed LDC design conditions. Because natural gas demand is expected to grow, similar weather conditions in the future could produce similar or higher natural gas and electric prices, unless additional infrastructure is built to alleviate constraints.

[4] Natural gas-fired electric generators do not have an electricity market mechanism to recover fixed demand charges associated with reserving capacity on interstate pipelines and thus rely on interruptible pipeline transportation, a circumstance that can cause increased competition for natural gas, and thus cause an increase in the price of natural gas and electricity.

SECTION 3:
ANALYSIS FRAMEWORK

For consistency, the updated analysis herein utilized the same framework and approach to the analysis as set forth in the Original Report.

As discussed in the Original Report, it is generally accepted that natural gas markets that are constrained during some or all of the year, and thus reflect higher and more volatile natural gas pricing during such periods, can benefit from additional pipeline capacity to mitigate the higher and more volatile pricing. Given this, the objective of Concentric's analysis was to estimate, based on the experience of the winter of 2017/2018, what the market area price of natural gas paid by customers could have been had an additional 1 Bcf/d of pipeline capacity been available to transport natural gas supplies into the eastern Pennsylvania and New Jersey region.

It should be noted that our updated analysis assumed that all other circumstances that existed in the winter of 2017/2018 were unchanged, including factors such as weather, operational issues, other natural gas supply and transportation infrastructure, and electric market infrastructure. Clearly, different circumstances going forward will produce different results. However, similar market conditions that have recently produced such high natural gas prices can occur again, and the analysis presented herein provides an estimate of the magnitude of the potential financial benefits to market participants that could have been attained if additional pipeline capacity had been available to provide greater access to natural gas, particularly when natural gas demand in this region was at its highest.

To determine the potential natural gas cost savings that could have been realized by energy consumers had an additional 1 Bcf/d of capacity been available this past winter due to PennEast, Concentric estimated the market area natural gas prices in eastern Pennsylvania and New Jersey that may have otherwise occurred during the winter of 2017/2018 (*i.e.*, November 1, 2017 through March 31, 2018).[5] We focused our analysis on this region since it is the area that will be directly served by PennEast, and thus, natural gas prices in this region will be most directly affected by the addition of such incremental pipeline capacity.[6]

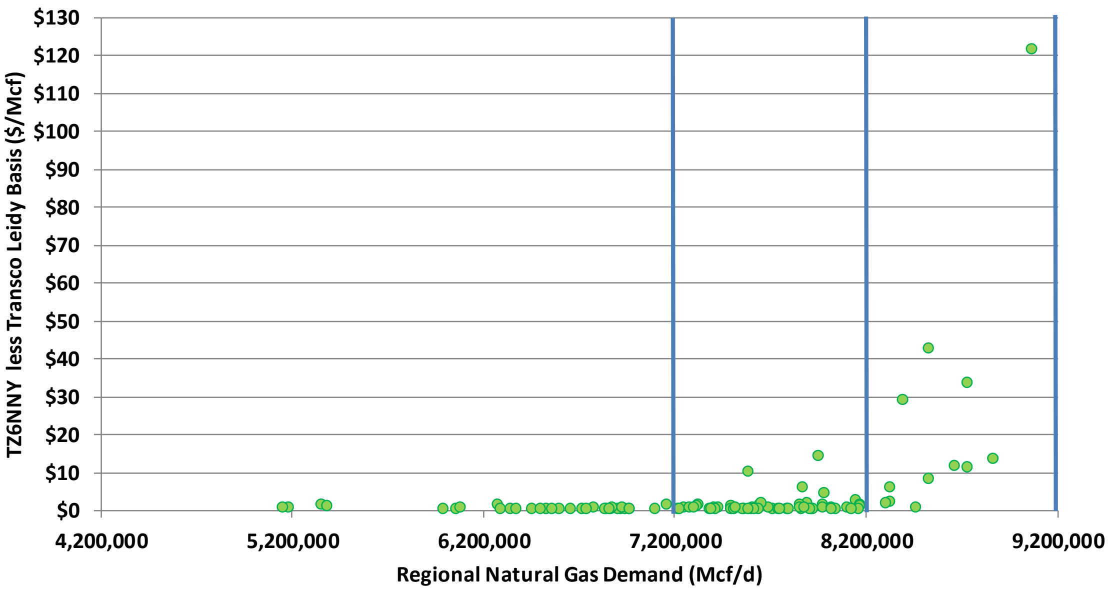
To estimate the natural gas price reductions that could have otherwise occurred with additional pipeline capacity, Concentric evaluated the basis differentials between Transco Leidy and TZ6NNY that occurred during the winter period of 2017/2018 relative to the amount of natural gas demand

5 In the United States natural gas industry, the winter period is typically defined as November 1 through March 31, and represents the period with the greatest demand for natural gas in most areas of the country, including eastern Pennsylvania and New Jersey.

6 Concentric recognizes that the availability of additional pipeline capacity in eastern Pennsylvania and New Jersey could not only reduce natural gas prices within this particular region, but, assuming there were no constraints during some or all of the year, also reduce natural gas prices in adjacent regions (*e.g.*, New York City) by increasing availability of natural gas in these adjacent markets as well. These lower natural gas prices could also reduce energy prices in the electric markets in adjacent areas. However, for purposes of this analysis, the estimated savings associated with 1 Bcf/d of incremental pipeline capacity was focused solely on eastern Pennsylvania and New Jersey.

experienced in eastern Pennsylvania and New Jersey each day. The published daily Transco Leidy index prices were used as a proxy for the production area price of natural gas to be received by PennEast, as this pricing point is reflective of natural gas receipts into Transco in eastern Pennsylvania from the Marcellus supply region. The published daily TZ6NNY index prices were used as a proxy for the prices of natural gas delivered by PennEast into the eastern Pennsylvania and New Jersey markets. The TZ6NNY index prices reflect the price of natural gas deliveries off of Transco for the region south and west of New York City, including eastern Pennsylvania and New Jersey. Figure 4 illustrates the relationship between demand and basis differentials for the region.

Figure 4:
Scatterplot of Winter 2017/2018 Natural Gas Demand and Basis Differentials



As expected, the daily basis differentials are high when demand is high, and basis differentials are lower when demand is low, reflecting the supply/demand balance in the market. The relationship between the daily basis differentials and natural gas demand for the region was utilized to develop revised basis differentials that were assumed would have otherwise occurred had an additional 1 Bcf/d of pipeline capacity been serving the region. The analysis assumed that the basis differentials on each day would have been reduced by a specific percentage had additional pipeline capacity been available. The assumed percentage reductions were established by calculating the average basis differential for all of the days in which the demand on those days was within a particular 1 Bcf increment ("tranche"), and then comparing the average basis differential from one tranche to the next tranche when demand was lower by 1 Bcf, or stated differently, pipeline supplies and capacity available to market participants was 1 Bcf higher.

For example, when demand during the observed period in the winter of 2017/2018 in eastern Pennsylvania and New Jersey was the highest – between 8.2 Bcf and 9.2 Bcf ("Tranche 1") – basis differentials were also generally relatively high, averaging over $24/Mcf and reaching as high as $122/Mcf. However, when demand was 1 Bcf lower – between 7.2 Bcf and 8.2 Bcf ("Tranche 2") – the basis differentials were much lower on average, and on many days under $2/Mcf. In fact, as shown in Table 1, the average basis differential associated with demand levels in Tranche 2 was 94%

lower than the average basis differential associated with demand levels in Tranche 1 (*i.e.*, the percentage difference between $23.58/Mcf and $1.38/Mcf). Thus, it was assumed that if an additional 1 Bcf/d of pipeline capacity had been available in the winter of 2017/2018, the basis differentials experienced on the days in which demand was highest (*i.e.*, between 8.2 and 9.2 Bcf/d) would have been 94% lower than they otherwise were. In other words, the analysis assumed that the basis differentials at those demand levels would have been more reflective of the basis differentials that were actually experienced when demand for pipeline capacity was approximately 1 Bcf/d lower, and thus a greater potential for parties to access natural gas supplies.

Table 2:
Assumed Basis Differential Reductions Based on Demand

		Avg. Basis Differential Winter 2017/18	% Change in Avg. Basis Relative to Next Tranche
Tranche 1:	8.2 Bcf/d to 9.2 Bcf/d	$ 23.58	94%
Tranche 2:	7.2 Bcf/d to 8.1 Bcf/d	$ 1.38	50%
Tranche 3:	0.0 Bcf/d to 7.1 Bcf/d	$ 0.69	n/a

This process for determining the percentage reduction in the basis differentials was also used for the days that experienced lower demand (*i.e.*, demand in Tranche 2), although as shown in Table 2, the assumed percentage reduction in the basis differentials were much lower or non-existent at the lower demand levels. Also, as shown in Table 2, the analysis assumed that if gas demand on a day was lower than 7.2 Bcf, then then there would have been no change in the actual basis differential.[7]

The revised market area price was determined by adding the revised basis differential to the actual production area price (*i.e.*, Transco Leidy) on each day. Thus, while the revised basis differentials were assumed to be reduced by the percentages noted in Table 2, the assumed reductions in the market area (*i.e.*, TZ6NNY) prices represented a lower percentage.[8] Also, if the revised basis differential was unchanged relative to the actual basis differential, the revised TZ6NNY price was assumed to be the same as the actual TZ6NNY price.

---

7 The basis differential between TZ6NNY and Transco Leidy has been relatively high during the non-winter period as well. For example, during the summer of 2017 (*i.e.*, April 2017 through October 2017), the TZ6NNY prices were more than $1.50/Mcf higher than the Transco Leidy prices on over 20 occasions. However, for purposes of this analysis, the impact of additional pipeline capacity from PennEast and potential savings to energy consumers in eastern Pennsylvania and New Jersey has not been evaluated for those non-winter periods.

8 For example, if the actual TZ6NYY price on particular day was $5.00/Mcf and the Transco Leidy price was $2.00/Mcf, the basis differential would have been $3.00/Mcf. Assuming the demand on that day was between 7.2 and 8.2 Bcf, then the assumed reduction in the basis differential on that particular day due to the addition of an additional 1 Bcf/d of capacity would have been 50%. Thus, the revised basis differential would have been $1.50/Mcf (*i.e.*, a 50% reduction from $3.00/Mcf), and the revised TZ6NNY price was assumed to be $3.50/Mcf (*i.e.*, the Transco Leidy price of $2.00/Mcf plus the revised basis differential of $1.50/Mcf). Therefore, this means that the percentage reduction in the actual TZ6NNY price relative to the revised TZ6NNY price on that particular day was assumed to be 30% (*i.e.*, the percentage reduction from $5.00/Mcf to $3.50/Mcf).

SECTION 4:
AREAS OF POTENTIAL ENERGY COST SAVINGS

Lower natural gas prices can provide benefits to energy consumers in a number of different respects. In the Original Report, Concentric evaluated four primary areas in which energy cost savings could have been achieved by consumers from lower natural gas prices due to the availability of an additional 1 Bcf/d of pipeline capacity. As discussed, Concentric has been asked to update each of the four primary areas evaluated in the Original Report (*i.e.*, Gas-Fired Generation Savings, Oil-Fired Generation Displacement Savings, Industrial Transport Customer Savings, and LDC Gas Supply Savings).

The approach utilized by Concentric to estimate savings for each area is described in more detail below, and is consistent with the approach utilized in the Original Report. As described, we estimate that had an additional 1 Bcf/d of pipeline capacity been available in the winter of 2017/2018, natural gas prices in eastern Pennsylvania and New Jersey would have otherwise been tempered and not reached the levels that they in fact did. Consequently, consumers in the region could have potentially saved approximately $435 million dollars in the winter of 2017/2018 for consumers in eastern Pennsylvania and New Jersey, which is in addition to the energy market savings of $890 million in the winter of 2013/2014 previously evaluated.

A. GAS-FIRED GENERATION SAVINGS

The wholesale generating resources in eastern Pennsylvania and New Jersey are a part of PJM, and natural gas-fired generation plays a critical role in PJM, with the costs of such generating resources often setting the price of power that consumers pay. Natural gas-fired generators operating in the competitive electric markets in these regions typically purchase gas at local spot market prices, meaning that they make daily purchases of natural gas when their facilities are called upon by PJM to operate. As a result, the availability of additional natural gas in eastern Pennsylvania and New Jersey during the winter of 2017/2018 could have lowered natural gas prices in this region and correspondingly reduced wholesale electric energy prices. In other words, if an additional 1 Bcf/d of capacity had been available to market participants in the winter of 2017/2018, thus dampening market area natural gas prices, that would in turn have translated into lower electric energy prices in those hours when electric prices were largely set by gas-fired generation.

Accordingly, for purposes of the analysis, Concentric utilized its estimate of lower natural gas prices to estimate the savings that could have been achieved in the electric market during hours in which natural gas-fired generation largely set the energy price in eastern Pennsylvania and New Jersey. To quantify the potential benefits to electricity customers, similar to the Original Report, we utilized the following information and assumptions pertaining to the winter of 2017/2018:

- Hourly electric energy prices reported by PJM for the day ahead energy market for the PJM zones in eastern Pennsylvania and New Jersey;[9]

---

9 The PJM zones for which hourly price and load were obtained were: the New Jersey Hub, Metropolitan Edison Company, PECO and PPL.

- Hourly electric demand (*i.e.*, load) for the PJM zones in eastern Pennsylvania and New Jersey;
- Data provided by the PJM market monitor regarding the fuel type of the generating units setting the electric energy prices in each hour.

The data provided by the PJM market monitor reflect the percentage of five-minute increments in each hour in which a specific fuel type set the energy price. Concentric assumed that the fuel type in each hour that set the price for the largest percentage of the five-minute increments established the price overall in that hour. To the extent that two or more fuel types set the energy price for an equivalent percentage of the five-minute increments in a particular hour, it was assumed that, if natural gas was one of those fuel types, natural gas-fired generation set the price in that hour. Alternatively, it was assumed that if an oil or oil-based fuel type was one of the fuel types that equally set the energy price in a particular hour (but natural gas was not), it was assumed that an oil-fired generating unit set the price in that hour. Table 3 provides a summary of the number of the hours in the winter of 2017/2018 in which it was assumed that natural gas-fired generation or oil-fired generation set the electric energy price in eastern Pennsylvania and New Jersey.

Table 3:
Number of Hours Natural Gas or Oil-Fired Generation Assumed to Set the Wholesale Electric Energy Price in Eastern Pennsylvania and New Jersey[10]

	Nat Gas	Oil
Nov-17	482	17
Dec-17	473	6
Jan-18	475	71
Feb-18	442	0
Mar-18	412	14
Total	**2284**	**108**

First, for each hour of the winter of 2017/2018, the actual electric energy cost was determined based on the energy price and electric demand data reported by PJM. Then, based on our analysis, if the estimated revised natural gas price applicable in any hour would have been lower had additional pipeline capacity otherwise been available, and natural gas was the marginal fuel setting the price of electric energy in that particular hour, an "adjusted" electric energy price was calculated. Specifically, the adjusted electric energy price was calculated by assuming that the percentage reduction in the natural gas price in any hour would translate into an equivalent percentage reduction in the electric energy price. For example, if the market area natural gas price (*i.e.*, the TZ6NNY price) was assumed to be reduced by 20% on a particular day due to the availability of additional pipeline capacity, then it was generally assumed that the electric energy prices in the hours of that day when the price was set by a natural gas-fired generating unit would have also been reduced by 20%. Therefore, for those hours during the winter of 2017/2018 in which natural gas was setting the electric energy price, a revised electric energy cost was calculated, which was then compared to the actual electric energy

10 Because the PJM marginal fuel data for March 2018 was not available as of the date of this report, PJM marginal fuel data for March 2017 was used as a proxy.

cost in that hour to determine the potential savings associated with providing additional pipeline capacity.

The exception is that Concentric conservatively assumed that there would be no such electric market savings on days when demand for pipeline capacity in eastern Pennsylvania and New Jersey was very high ("extreme peak days"). Currently, during the winter peak period, gas is primarily flowing from the Marcellus and Gulf Coast producing areas to markets in eastern Pennsylvania and New Jersey and the major pipelines serving the area are very highly utilized. PennEast would provide an additional 1 Bcf/d of capacity to the region generally and, as discussed, thus tend to reduce natural gas prices that would otherwise be experienced. However, during periods of extremely high demand when pipeline capacity in the region is highly constrained, the addition of such additional capacity may not result in lower market area prices in areas north (or downstream) of the terminus of PennEast without additional pipeline capacity on other pipelines (*e.g.*, Transco or TETCO) to allow additional gas to reach markets in northern New Jersey.

As a result, shippers (*e.g.*, LDCs) that directly connect to PennEast, or hold pipeline capacity to take gas from PennEast to points north of PennEast, will still achieve benefits, even on extreme peak days; however, parties that have not contracted for pipeline capacity and are paying local market prices may not see a price benefit provided by the additional capacity of PennEast on extreme peak days when pipeline utilization is very high. In contrast, Concentric expects that parties south of the terminus of PennEast would be able to realize a benefit from lower gas prices resulting from the addition of PennEast capacity throughout the winter, including on extreme peak days, either through upstream capacity on other pipelines not being utilized because of parties using PennEast capacity, or through the ability to effectuate deliveries in those locations through displacement or backhauls.

While information is available regarding when gas-fired generating units set the electric energy price in PJM, information is not publicly available as to which gas-fired generating unit or the location of the unit setting the price. Based on the assumption that lower natural gas prices may not be realized at points north of the terminus of PennEast during extreme peak days, and since it is not known whether the location of the generation unit setting the electric energy price was north or south of PennEast, it was conservatively assumed that no savings would be achieved by lower electric energy prices on extreme peak days.

Consistent with the Original Report, Concentric defined an extreme peak day as any day when heating degree days ("HDDs") were greater than 46.[11] Because all of these cold, high demand days were in Tranche 1, it was estimated that the basis differential between Transco Leidy and TZ6NNY would have otherwise been reduced by 94%, and thus the TZ6NNY price would have also been reduced, due to an incremental 1 Bcf/d of pipeline capacity into the region. However, since demand on those days was very high, and thus have been defined herein as extreme peak days, the natural gas price benefit in the market area on such days was conservatively assumed to not flow through to the electric market for purposes of estimating the savings herein.

[11] HDDs are defined as the magnitude of the difference that the actual temperature is less than 65 degree Fahrenheit. For example, if the average daily temperature on a particular day was 19 degrees Fahrenheit, then that day would be characterized as having 46 HDDs (*i.e.*, the difference between 65 and 19).

Based on its analysis, Concentric estimated that electric consumers in eastern Pennsylvania and New Jersey could have saved approximately $138 million and $100 million, respectively, in the winter of 2017/2018 had an additional 1 Bcf/d of capacity been available to temper natural gas prices when gas-fired generators set the electric price. Concentric recognizes that the electric energy markets are very complex, reflecting the bidding behavior of numerous generating units based on their respective cost structures, market strategies and market conditions. As described, the analysis reflected herein makes the simplifying assumption that all else would have been equal in a circumstance in which natural gas prices were reduced. While this may not have in fact been the case, we believe it is a reasonable means of estimating the savings that could have otherwise been achieved in the wholesale electric market associated with gas-fired generation had additional pipeline capacity been available this past winter.

B. OIL-FIRED GENERATION DISPLACEMENT SAVINGS

Electric generation fueled by oil-based products (*e.g.*, light fuel oil, heavy fuel oil, kerosene) are generally more expensive than other forms of generation and thus are utilized to produce power only during periods of peak electric demand when less expensive generating resources are either already operating or otherwise unavailable. The availability of 1 Bcf/d of incremental pipeline capacity into eastern Pennsylvania and New Jersey in the winter of 2017/2018 would have created an opportunity for natural gas-fired generation that was unable to purchase natural gas, either due to constrained pipeline capacity or because gas prices were too high, to operate instead of oil-fired generation in those hours when oil-fired generation was called upon by PJM to operate. Effectively, the availability of additional natural gas could have created the opportunity for natural gas-fired generation to displace oil-fired generation, and thus potentially lower costs to electric consumers in the hours in which such displacement could have occurred. Additionally, over the longer-term, with increased access to natural gas supplies, lower cost natural gas-fired generating capacity could also be constructed to displace the more expensive oil-fired generating units, creating the further opportunity for future savings to electric consumers.

Accordingly, Concentric estimated the savings that may have been achievable in the electric market during hours in which oil-fired generation set the electric energy price in eastern Pennsylvania and New Jersey during the winter of 2017/2018. This analysis relied upon the same hourly pricing, load and marginal fuel data from PJM as just described in the Gas-Fired Generation Savings analysis. Furthermore, it was assumed that in those specific hours when oil-fired generation was setting the electric energy price, that price would have otherwise been no higher than the electric energy price in an hour during that same day when the electric energy price was set by a natural gas-fired generator. Thus, the estimated savings in those hours when oil-fired generation was setting the electric energy price were based on the difference between the actual electric energy price and the revised electric energy price estimated to have occurred if additional natural gas pipeline capacity and supply had been available, multiplied by the applicable load in that hour. Again, however, the exception is that Concentric's analysis also conservatively did not assume any savings associated with natural gas-fired generation displacing oil-fired generation during extreme peak days. This was done for the same reasons previously discussed regarding the Gas-Fired Generation Savings analysis.

With the opportunity for oil-fired generation to be displaced by lower cost natural gas-fired generation, it is estimated that electric consumers in eastern Pennsylvania and New Jersey could have saved approximately $5 million and $3 million, respectively, in the winter of 2017/2018 had an additional 1 Bcf/d of capacity been available to temper natural gas prices.

C. INDUSTRIAL TRANSPORTATION CUSTOMER SAVINGS

Unlike most residential and smaller commercial natural gas customers, many industrial customers, which can have very substantial daily natural gas requirements, procure their own natural gas supplies as opposed to having their LDC purchase such supplies on their behalf. Such industrial customers are referred to as "transportation" customers of the LDC since the LDC only has to transport gas through its distribution system, not purchase the gas for these industrial customers.[12] Industrial transportation customers generally purchase their supplies from third-party marketers and these supplies are typically priced based on market area price indices (as opposed to production area price indices reflective of Marcellus or Gulf Coast prices).

To estimate the savings that industrial transportation customers in eastern Pennsylvania and New Jersey may have achieved in the winter of 2017/2018 due to additional pipeline capacity dampening market area natural gas prices, Concentric first determined the total natural gas demand for these customers. Table 4 illustrates the 2016 annual demand for the industrial transportation customers in the service territories of the LDCs in eastern Pennsylvania and New Jersey.[13]

Table 4:
2016 Annual Natural Gas Demand for the Industrial Transportation Customers in Eastern Pennsylvania and New Jersey

	Annual Demand (Mcf)	Assumed Daily Demand (Mcf/d)
Eastern Pennsylvania		
PECO Energy	25,152,670	68,911
Philadelphia Gas Works	6,656,713	18,238
UGI Penn Natural Gas	19,839,466	54,355
UGI Utilities	35,251,138	96,578
Subtotal	**86,899,987**	**238,082**
New Jersey		
New Jersey Natural Gas	1,346,153	3,688
Elizabethtown Gas	10,778,195	29,529
Public Service Electric & Gas	33,739,752	92,438
South Jersey Gas	11,387,099	31,198
Subtotal	**57,251,199**	**156,853**

While natural gas usage patterns vary by customer based on their specific circumstances, industrial customers' demand as a whole is generally much less weather-sensitive than it is for residential and

12 Customers for which the LDC both purchases natural gas supply and pipeline transportation service, as well as distributes that gas to the customer, are known as "sales" customers.

13 The 2016 data was the most recently available information at the time this analysis was conducted.

commercial natural gas customers. Therefore, it was assumed that these industrial customers have consistent demand throughout the year.

Next, to estimate the potential savings that these customers could have achieved, Concentric assumed that all of the industrial transportation customers in eastern Pennsylvania and New Jersey purchase their natural gas supplies at market-area prices, and thus would have benefitted from additional pipeline capacity lowering the market area spot natural gas prices last winter. Thus, the estimated savings for the industrial transportation customers were calculated by multiplying the daily demand for these customers by the difference between the actual market area price (again, the TZ6NYY price) and the revised market area price discussed previously. Again, the exception was that no savings were assumed to be achievable by industrial transportation customers in northern New Jersey on extreme peak days. As described previously, the analysis conservatively assumed that market area prices north of PennEast would not be reduced as a result of additional capacity on extreme peak days, and thus industrial transportation customers located north of PennEast in northern New Jersey that were purchasing natural gas supplies at market area prices would not have achieved the benefit of a natural gas price reduction on extreme peak days.[14]

Based on the analysis, it is estimated that industrial transportation consumers in eastern Pennsylvania and New Jersey could have saved approximately $106 million and $37 million, respectively, in the winter of 2017/2018 had an additional 1 Bcf/d of capacity been available and otherwise dampened market area natural gas prices.

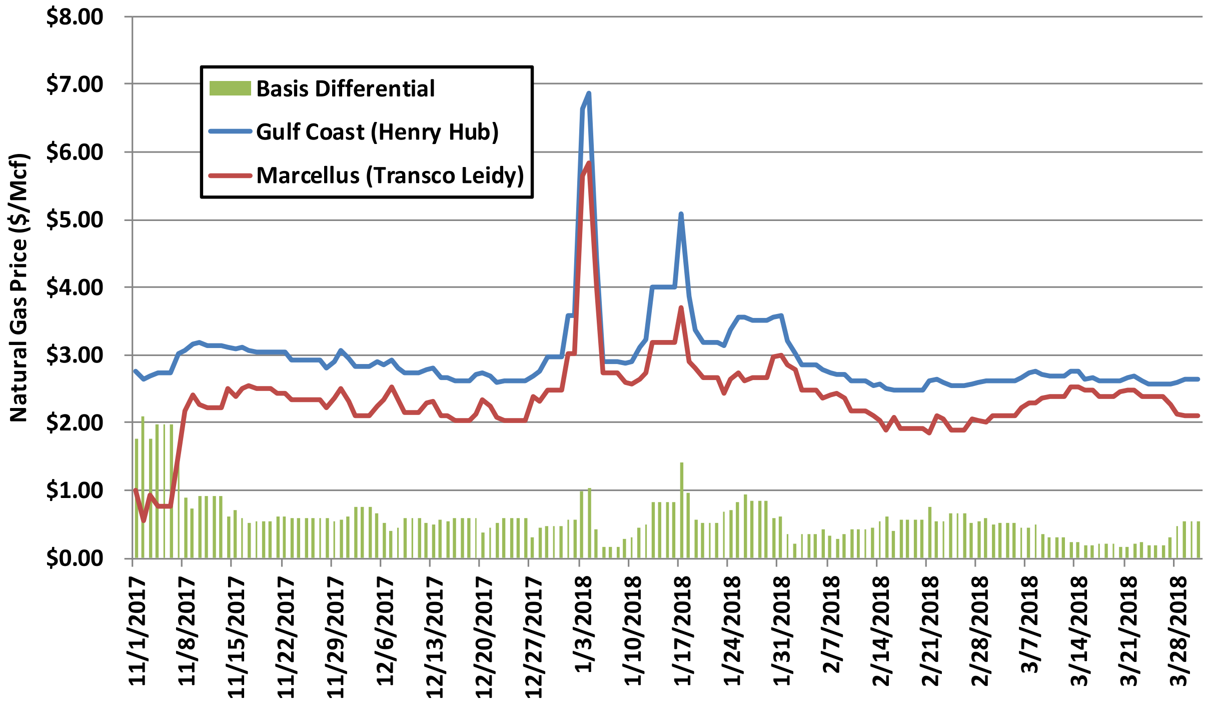
D. LDC GAS SUPPLY SAVINGS

Most LDCs do not purchase a significant amount of natural gas to serve their sales customers at market area prices, but rather purchase supplies directly in producing areas and transport the gas over long-haul pipelines to their distribution systems. Thus, most LDC customers are largely insulated from market area price spikes, such as occurred in the U.S. Northeast in the winter of 2013/2014 and again in the winter of 2017/2018. LDCs in the Northeast have traditionally relied upon gas supply purchased in the Gulf Coast, transporting that gas via long-haul pipelines to their service territories. However, with the advent of significant natural gas supply development in the Marcellus and Utica shale basins located close to the Northeast markets, many LDCs have diversified a portion of their gas supply portfolios to access natural gas from the Marcellus and Utica basins. The continued prolific development of natural gas supplies from these shale basins has caused an abundance of supply in the region, and thus prices in these producing regions have consistently traded below the prices for natural gas produced along the Gulf Coast. Figure 5 illustrates the

14 Concentric assumed that the demand associated with the industrial transportation customers of PSEG and Elizabethtown were representative of the industrial transportation customer demand in northern New Jersey that may not otherwise benefit on an extreme peak day from a natural gas price reduction associated with incremental pipeline capacity. The entire service territory of these two LDCs is not located in northern New Jersey. In addition, a portion of NJNG's service territory is also located in northern New Jersey. However, for purposes of the analysis, Concentric believes that using the demand of the industrial transportation customers of PSEG and Elizabethtown as representative of such demand in northern New Jersey is reasonable.

differences in natural gas prices in the Marcellus versus the Gulf Coast during the winter of 2017/2018.

Figure 5:
Natural Gas Price Differences between the Marcellus and Gulf Coast Producing Areas for the Winter of 2017/2018



The basis differential between natural gas prices in the Marcellus and along the Gulf Coast creates an opportunity for LDCs to attain savings by switching the location of their purchases from the Gulf Coast to the Marcellus. Concentric has not evaluated whether or to what extent LDCs in eastern Pennsylvania and New Jersey have shifted their natural gas purchases, or whether they intend to do so in the future. Rather, for purposes of the analysis, Concentric has assumed that half of the 1 Bcf/d of capacity of PennEast could have been utilized to purchase Marcellus supplies rather than Gulf Coast supplies. Additionally, Concentric assumed that pipeline transportation costs, including the cost required for pipeline fuel, are equivalent from the Gulf Coast versus the Marcellus, and that LDCs would have been able to realize the full pricing differential between the Gulf Coast and Marcellus prices.

Accordingly, it is estimated that LDCs in eastern Pennsylvania and New Jersey could have saved approximately $45 million in the winter of 2017/2018 had PennEast been available and provided an opportunity for greater reliance on relatively cheaper Marcellus production. Allocating the total savings to eastern Pennsylvania and New Jersey based on each region's respective gas sales volumes for 2016 would result in an estimated savings of $15 and $30 million, respectively.

SECTION 5:
ANALYSIS RESULTS

Table 5 summarizes the estimated savings for each of the four categories that Concentric evaluated in this updated analysis, with the savings presented separately for eastern Pennsylvania and New Jersey.

Table 5:
Estimated Energy Savings if an Additional 1 Bcf/d of Pipeline Capacity Had Been Available in the Winter of 2017/2018

(All figures in $Millions)	Eastern Pennsylvania	New Jersey	Total
Electric Market Savings			
Gas-Fired Generation	$ 138	$ 100	$ 238
Oil-Fired Generation Displacement	$ 5	$ 3	$ 8
Subtotal	$ 143	$ 104	$ 246
Gas Market Savings			
LDC Gas Supply Procurement	$ 15	$ 30	$ 45
Industrial Transportation Customer	$ 106	$ 37	$ 144
Subtotal	$ 121	$ 67	$ 189
Total Estimated Savings:	**$ 264**	**$ 171**	**$ 435**

As reflected in Table 5, it is estimated that energy consumers in eastern Pennsylvania and New Jersey could have saved approximately $435 million in total during the winter of 2017/2018, had an additional 1 Bcf/d of incremental natural gas pipeline capacity been available, with approximately 57% of those savings benefiting electric customers and 43% benefiting natural gas customers. These estimate savings for the winter of 2017/2018 are in addition to the estimated energy market savings of $890 million that could have been achieved in the winter of 2013/2014 previously evaluated in the Original Report.

It is important for policy makers and other stakeholders to understand that in periods of elevated demand when market area natural gas prices can increase significantly, the opportunity for achieving consumer savings from lowering natural gas prices through additional pipeline capacity can be substantial. As discussed, the analysis herein has excluded potential savings in the electric market and for industrial transportation customers in northern New Jersey on extreme peak days, which are the days when natural gas demand and market area gas prices were highest. Therefore, to the extent that additional infrastructure such as PennEast could have also had the effect of reducing market area natural gas prices on those extreme peak days, there is the potential that significant savings in addition to the savings reflected in Table 5 could have been achieved.

CONCENTRIC
ENERGY ADVISORS

WWW.CEADVISORS.COM