The Economic Impact of New Pipeline Infrastructure

South Carolina, North Carolina, & Georgia

May 2018

UNIVERSITY OF
SOUTH CAROLINA
Darla Moore School of Business

Study Prepared by:
Dr. Joseph C. Von Nessen
Research Economist, Division of Research
joey.vonnessen@moore.sc.edu

Prepared for: American Petroleum Institute (API)

Executive Summary

The purpose of this study is to estimate the economic impact that a new, hypothetical, refined petroleum products pipeline could have on the tri-state Southeastern region of South Carolina, North Carolina, and Georgia. This analysis will include both the impacts resulting from pipeline construction and ongoing operations. Although the source of the petroleum products for the hypothetical pipeline was left undefined and conservative assumptions regarding the length of the pipeline route were made, the estimates in this study nevertheless provide a foundation upon which to evaluate the impact of any future pipeline infrastructure in the tri-state region, with longer or shorter routes having proportionately larger or smaller impacts.

Also examined are the economic losses the tri-state region experienced due to recent supply disruptions and the potential implications of cost savings to tri-state consumers that could result from additional pipeline infrastructure in the Southeastern United States. Estimates of cost savings again serve as a foundation to evaluate future pipeline infrastructure, as actual cost savings would depend on many factors, including the exact source of supply, pipeline route, and nature of the disruption.

All impacts documented in this report for the tri-state region will exceed the sum of the impacts documented in the individual state reports. In those reports, state-level impacts do not account for economic spillover effects – that is – the additional impacts that occur within a state resulting from pipeline construction/operations in neighboring states. For example, South Carolina would likely experience a positive economic gain from the construction of a new pipeline in Georgia because a small portion of the new spending activity that results, either from businesses or individuals, would likely occur in neighboring South Carolina.

The key findings of this study are as follows:

- *A new, hypothetical, refined petroleum products pipeline constructed in the tri-state region of comparable size and scope to the existing Colonial and Plantation pipelines would likely measure 27 inches in diameter and span, at minimum, approximately 620 miles across the region.*

- *The economic impact of the construction of such a pipeline in the tri-state region is estimated to add $310.2 million to Gross Regional Product. This figure reflects the dollar value of all final goods and services produced in the tri-state region that would be the result of (either directly or indirectly) the construction of the pipeline.*

- *Based on the timeline of other similar projects across the United States, the construction phase of this new regional pipeline would be anticipated to last between eight and twelve months. This study estimates that 2,763 construction and construction-related workers would be employed during the construction phase.*

- *Additional rounds of economic activity due to non-labor expenditures associated with pipeline construction and the local spending of workers would generate an additional 1,803 jobs during the construction phase. Thus, a total of 4,566 temporary jobs across the tri-state region would likely be supported during the construction of the new pipeline. This impact corresponds to over $192 million in labor income.*

- *Upon completion of the pipeline, the ongoing activities that would be required to sustain all operations and maintenance are estimated to generate a permanent increase in regional economic activity of approximately $58.5 million per year. This impact is associated with 584 new, permanent jobs and $38.7 million in annual labor income.*

- *To put the economic impact of supply disruptions in context, consider that there have been at least three major weather events to cause significant disruptions to the supply of refined petroleum products to the tri-state region since 2005. These consist of Hurricane Katrina (August 2005), Hurricane Harvey (August 2017), and Hurricane Irma (September 2017). During the aftermath of Hurricane Katrina, a temporary supply constraint contributed to gasoline prices in the tri-state region increasing by 12 cents per gallon relative to the national average. During the aftermath of Hurricanes Harvey and Irma, a similar temporary price increase of approximately 16 cents per gallon occurred. Price increases resulting from future supply disruptions could potentially be avoided or lessened with additional pipeline infrastructure (e.g. a pipeline connected to a different supply source than Colonial and Plantation).*

- *The temporary price increase due to petroleum supply constraints following Hurricane Katrina in 2005 lasted for approximately two months. During this period, the price increase is estimated to have generated nearly $114 million in total economic losses for the tri-state region. These include both the direct losses to consumers as well as all losses arising from economic multiplier effects associated with decreased regional demand resulting from a lower volume of consumer spending activity.*

- *Similarly, the temporary price increase due to petroleum supply constraints following Hurricanes Harvey and Irma in 2017 lasted approximately nine weeks. During this period, the price increase is estimated to have generated approximately $387 million in total economic losses for the tri-state region. As with Hurricane Katrina, these include direct losses to consumers and those arising from decreased overall regional demand resulting from a lower volume of consumer spending activity.*

Table of Contents

Section I – Introduction and Background

In recent years, the Southeastern United States has emerged as one of the leading U.S. regions for population growth. For example, the share of the U.S. population living in the Southeast increased from approximately 30 percent in 1970 to 54 percent as of 2017.[1] These growth trends also extend to many individual states, including those in the tri-state region of South Carolina, North Carolina, and Georgia. The source for much of this population growth has been strong economic growth. This can be illustrated through the fact that the Georgia, South Carolina, and North Carolina economies have ranked 5th, 6th, and 8th (respectively) among all states in their rates of GDP growth since 2012.[2]

Because of these trends, the tri-state region of South Carolina, North Carolina, and Georgia is likely to experience a significant increase in the demand for petroleum products over time that will both outpace the United States average and eventually require an increase in supply of pipeline infrastructure to serve. At the national level, the U.S. Energy Information Administration (EIA) projects that total energy consumption will increase at an average annual rate of approximately 0.3 percent through the year 2050.[3]

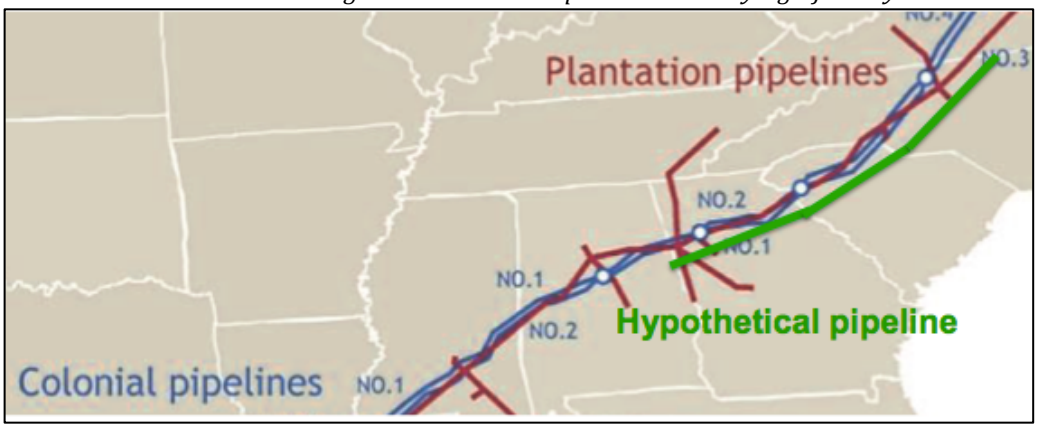
Not only does maintaining an appropriate level of pipeline infrastructure help to meet increases in petroleum demand, it also has the potential to generate further economic gains for the tri-state region by creating jobs and incomes for residents of the tri-state region and by minimizing supply disruptions – that is – by allowing the region to more easily accommodate either an increase in demand or a temporary disruption in existing supply without a significant accompanying increase in price for the average consumer. For example, consider the recent petroleum supply disruptions in the tri-state region due to Hurricanes Harvey and Irma that resulted in a short-run increase in gasoline prices of between 30 and 50 cents per gallon.

[1] Source: U.S. Census, Annual Population Estimates
[2] Source: U.S. Bureau of Economic Analysis
[3] Source: U.S. Energy Information Administration, Annual Energy Outlook 2017

This price increase may have potentially been avoided or minimized if additional pipeline capacity following a different route or sourced from a different location had been available.

The purpose of this research effort is to conduct an analysis that estimates the economic impact on the South Carolina, North Carolina, and Georgia tri-state region that would result from a new, hypothetical, refined petroleum products pipeline that would traverse the state. Such a pipeline would augment the existing Colonial and Plantation pipeline supply and likely follow a similar route, as denoted in Figure 1.

Figure 1 – Hypothetical Pipeline Route: Georgia, South Carolina, and North Carolina
Note: Actual origin and destination points could vary significantly



The economic impacts resulting from the new, hypothetical pipeline documented in this report include: (1) estimates of all economic activity generated as a result of the *construction* and *ongoing operations* of the new pipeline and (2) estimates of all economic activity *preserved* as a result of additional pipeline capacity that would have the potential to reduce price increases in the event of any major supply constraint (e.g. a natural disaster). This report is organized as follows: Section II highlights the economic impact methodology used to quantify all estimates in this report; Section III specifically documents the economic impact of pipeline construction – including all impacts resulting from the economic multiplier effect; Section IV focuses on the economic impacts of ongoing pipeline operations and maintenance; Section V examines the impact that additional pipeline infrastructure

can have on minimizing supply disruptions; finally, Section VI offers a brief conclusion.

Section II – Economic Impact Methodology

Estimating the economic impact of any new business activity starts by examining all direct procurement that occurs within the region, which includes both labor and non-labor expenditures. The construction and operations of a refined petroleum products pipeline would both employ a large workforce and also support local suppliers through various non-labor expenditures.[4] Expenditures made with local businesses and through wages and salaries paid to employees introduce new spending activity at a regional level that would not exist otherwise and thus represent a net increase in total economic activity for the tri-state region.

Yet these activities do not provide a complete picture of the impact of a new, refined petroleum products pipeline to the tri-state region's economy. The expenditures outlined above only represent direct economic activity within the region. However, these expenditures also lead to additional job creation and economic activity throughout the region by way of the economic multiplier effect (or economic ripple effect).

Economic multiplier effects can be divided into *direct, indirect,* and *induced* impacts. The direct effect represents the initial change in economic activity. This includes, for example, the initial dollars that are injected into the economy of the tri-state region directly through the construction and maintenance activity of the pipeline. This would include any employee wages and benefits, pipeline materials purchased, transportation equipment, or other overhead and administrative costs. This spending increases demand for goods and services and leads to the creation of new

[4] These expenditures would likely include building infrastructure and a variety of purchases from professional service providers. It should also be noted that many pipeline-related manufactured goods would likely be purchased outside of the region and thus would not be part of the local supply chain.

jobs and more income for employees and suppliers of any construction maintenance firms that are hired.

The indirect effect reflects all of the additional economic impacts resulting from inter-industry linkages between other local businesses in the region. For example, consider a local purchase that is made to replace existing pipeline infrastructure as part of standard maintenance. In this situation, the equipment provider would, as a result of this purchase, experience an increase in demand. This would require this equipment provider to purchase additional raw materials to accommodate the new increase in demand and to potentially hire additional employees if the increase in demand were high enough. Any regional vendors of the equipment providers would then experience an increase in demand and have to purchase additional inputs as well, and so on. These indirect effects ripple through the economy of the tri-state region.

The induced effect reflects additional economic activity that results from increases in the spending of household income. For example, when the aforementioned equipment provider hires new workers to satisfy an increase in demand, these workers will earn incomes. They will then spend part of this new income locally on, for example, food, entertainment, or housing. These industries will then see an increase in demand for their goods and services, which will lead to higher incomes for some of their employees, part of which will also be spent locally.

These successive rounds of indirect and induced spending do not go on forever, which is why a specific value can be calculated for each of them. In each round, money is "leaked out" for a variety of reasons. For example, firms may purchase some of their supplies from vendors located outside of the local area. In addition, employees will save part of their income or spend part of it with firms located outside of the Southeast. In order to determine the total economic impact that will result from an initial direct impact, economic multipliers are used. An economic multiplier can be used to determine the total impact (direct, indirect, and induced)

that results from an initial change in economic activity (the direct impact). Multipliers are different in each sector of the economy and are largely determined by the size of the local supplier network as well as the particular region being examined. In addition, economic multipliers are available to calculate not just the total impact, but also the total employment and income levels associated with the total impact. To estimate the economic impacts in this study, detailed structural models (known as input-output models) of South Carolina, North Carolina, and Georgia that contain specific information on economic linkages between all industries within each state were used. The input-output modeling software *IMPLAN* was used to calculate all estimates.

All impacts documented in this report for the tri-state region will exceed the sum of the impacts documented in the individual state reports. In those reports, state-level impacts do not account for economic spillover effects – that is – the additional impacts that occur within a state resulting from pipeline construction/operations in neighboring states. For example, South Carolina would likely experience a positive economic gain from the construction of a new pipeline in Georgia because a small portion of the new spending activity that results, either from businesses or individuals, would likely occur in neighboring South Carolina.

Section III – Economic Impact: Pipeline Construction

The first set of economic impacts to be documented in this report are those resulting from all construction activities associated with building new pipeline infrastructure in the tri-state region. Any economic impacts that arise from construction activities will be the result of dollars invested within the region through purchases of various construction-related materials/services and through direct purchases of labor (e.g., employee wages).

Modeling Assumptions

Because the pipeline project being analyzed in this study is hypothetical in nature, specific assumptions had to be made regarding the pipeline's dimensions (length

and diameter) and its route through the tri-state region. Although neither the exact dimensions nor the exact route of any new pipeline is currently known, the economic impacts described in this report would likely be approximately scalable to any actual pipeline that is constructed.

There is a wide range of possible sizes for a new petroleum pipeline in the tri-state region, with most current pipelines in the United States being between 12 and 36 inches in diameter. Using the current diameters of the Colonial and Plantation pipelines running through Georgia, South Carolina, and North Carolina as a baseline reference, this study made the assumption that a likely diameter for any new petroleum pipeline constructed in the tri-state region would be 27 inches.[5]

The length of the new pipeline was assumed to be 620 miles across the tri-state region. This is the approximate distance for a route starting in Columbus, GA that would then head directly to Anderson, SC, then to Charlotte, NC, and finally ending in Murfreesboro, NC. A route across these four cities would roughly parallel that of the Colonial and Plantation pipelines. This 620-mile estimate represents a conservative projection of length, implying that the final route of any new pipeline may be considerably longer. A longer pipeline route, in turn, would also increase the final economic impact to the tri-state region.

To determine the number of workers required for a 27-inch pipeline built across 620 miles, employment data were obtained from a 2014 report issued by the U.S. Department of State that estimated the economic impact of the Keystone XL Project on the United States.[6] Among other things, the report estimated that the 875-mile Keystone XL pipeline would support approximately 3,900 annual average jobs

[5] This assumption was provided to the DOR by the American Petroleum Institute (API) and reflects the expert opinions of personnel regularly involved in examining and overseeing pipeline projects across the United States.
[6] https://keystonepipeline-xl.state.gov/finalseis/

within the 4-state region in which the pipeline was to be constructed.[7] Using this job/pipeline-mile construction ratio, this implies that about 2,763 average annual (direct) jobs would be supported from a new 620-mile pipeline in the tri-state region during the construction period. In order to estimate the construction costs associated with building this new pipeline, data were obtained from API documenting the current average cost parameters for pipeline infrastructure in the United States along with the relative distribution of purchase activities.[8]

Primary Results

The structural input-output models used to estimate all impacts in this report generate economic impacts in terms of three specific measures: gross regional product, employment, and labor income. Gross regional product is defined as the dollar value of the final goods and services purchased that can be attributed (directly or indirectly) to all construction activity that results from the construction of the new pipeline. It can also be thought of as an all-inclusive measure of the impact on total economic activity. Employment measures the impact on jobs in terms of the total number of average annual positions. Labor income represents total employee compensation, including wages, salaries, and benefits.

As described above, this report assumes that a hypothetical 27-inch, 620-mile pipeline in the tri-state region would require approximately 2,763 average annual jobs to build. These direct economic impacts also lead to indirect and induced impacts through increases in demand for goods and services in other related industries and through increases in household spending activity – all of which are estimated using economic multipliers. Each impact is reported in Table 1, along with

[7] This estimate reflects all jobs needed in construction and construction-related contractor services. An "annual average job" is defined as the total number of construction-related positions multiplied by the average number of weeks per construction period (19.5) divided by the total number of weeks in a year (52). See *U.S. Dept. of State Supplemental Environmental Impact Statement for the Keystone XL Project* for more details at https://keystonepipeline-xl.state.gov/finalseis/

[8] Source: *Feasibility and Impacts of Domestic Content Requirements for U.S. Oil and Gas;* ICF Report submitted to API on May 16, 2017

the accompanying totals. These totals represent the overall impact of the construction phase of the new hypothetical pipeline on the tri-state region.[9]

Table 1 – Total Economic Impact of Pipeline Construction in Tri-State Region[10]

	Direct Impact	Indirect Effect	Induced Effect	Total Impact
Employment	2,763	777	1,026	4,566
Labor Income	$104.6M	$43.6M	$43.9M	$192.1M
Gross Regional Product (GRP)	$155.7M	$72.1M	$82.4M	$310.2M

The 2,763 average annual jobs that would likely be created (along with all associated non-labor expenditures) generate approximately $155.7 million in annual regional GDP. This level of direct economic activity leads to indirect and induced effects totaling approximately $154.5 million in regional GDP and 1,803 jobs. These estimates reflect the increased demand for goods and services of local suppliers resulting from local expenditures as well economic activity in the tri-state region generated across all industries resulting from increases in household spending. The combination of the direct, indirect, and induced effects leads to a total economic impact of approximately $310.2 million, which is associated with 4,566 jobs across South Carolina, North Carolina, and Georgia. These results can also be broken down at the state level and by major industry sector as denoted in Tables 2 and 3.

[9] To estimate the results in Table 1, the analysis-by-parts (ABP) method was used to ensure that the construction sector was sufficiently disaggregated to accurately capture the purchasing effects that differentiate oil and gas pipeline construction (NAICS code 237120) from the more aggregated construction sector (two-digit NAICS code 23) that is incorporated into the default *IMPLAN* model software settings.

[10] The economic impact of this hypothetical pipeline on the United States would be significantly larger than the estimates reflected in Table 1. This study, however, focuses exclusively on the impacts to South Carolina, North Carolina, and Georgia. Estimates reflect average annual impacts for the entirety of the pipeline construction period. API estimates that a 620-mile pipeline would likely require twelve spreads working for 8 to 12 months.

Table 2 – Total Economic Impact of Pipeline Construction by State

	South Carolina	North Carolina	Georgia
Employment	939	1,899	1,728
Labor Income	$37.4M	$78.7M	$76.0M
Gross Regional Product (GRP)	$62.0M	$121.9M	$126.3M

Table 3 – Total Economic Impact of Pipeline Construction in Tri-State Region
Top Industrial Sectors

Industry Sector	Total Employment	Total Labor Income	Total Gross Regional Product
Construction	3,044	$118.0M	$182.7M
Wholesale and Retail Trade	451	$19.7M	$34.7M
Prof. Svs. & Mgmt. of Companies	164	$12.6M	$14.0M
Administrative and Waste Services	160	$5.5M	$6.6M
Health and Social Services	153	$9.1M	$10.5M
Accommodations and Food Svs.	149	$3.4M	$5.1M
Other Services	127	$5.1M	$5.8M
Real Estate and Rental	105	$3.6M	$27.3M
Manufacturing	91	$6.3M	$10.5M
Finance and Insurance	84	$5.1M	$7.4M

Section IV – Economic Impact: Operations and Maintenance

The second set of economic impacts to be documented in this report are those that would result from the ongoing operations and maintenance of the hypothetical pipeline. These include (1) regular spending on construction maintenance that will be required for proper upkeep of the new pipeline infrastructure over time and (2) the property tax revenue that will be collected from each state as a result of the pipeline construction and then re-spent in that state's economy – thereby increasing demand across a variety of industrial sectors.[11]

[11] This study does not take a position regarding the appropriate use of new property tax dollars collected. The assumption that new property tax dollars collected as a result of the ongoing operations of a new pipeline would be spent was made for the sake of simplicity.

Modeling Assumptions

The required costs to regularly maintain pipeline infrastructure in the United States have been recently estimated at the national level by IHS Economics.[12] These cost estimates reflect the direct economic activity associated with pipeline maintenance. Specifically, IHS Economics estimates that among 6,805 miles of newly built oil transmissions lines in the United States in 2016, the required operations and maintenance (O&M) spending generated approximately 2,156 jobs. As Table 4 highlights, this translates into a ratio of 0.3 jobs per mile. This ratio can then be applied to the 620-mile hypothetical pipeline in the tri-state region to determine the number of permanent annual direct jobs that are likely to result from its ongoing maintenance.

Table 4 – Annual Direct O&M Employment Impact of Newly Built Crude Oil Transmission Lines in 2016

Economic Metric	Direct Impact
Direct Employment	2,156
Total Pipeline-Miles	6,805
----------	----------
Direct Employment per Mile	***0.3***

In addition to the permanent increase in economic activity resulting from ongoing O&M associated with the pipeline, there will also be a permanent increase in spending that results from increased tax revenue that is collected and then re-spent within the local economy. For the purposes of this study, it was assumed that any hypothetical pipeline would be taxed at a rate of 0.78 percent – the average effective property tax rate across the tri-state region.[13]

Primary Results

Combining the economic activities associated with ongoing O&M and property tax dollars that are collected and then re-spent locally yields a permanent total increase in economic activity of $58.5 million in annual regional GDP, which is associated

[12] This report, entitled *The Economic Impact of Crude Oil Pipeline Construction and Operation* was released by IHS Economics in February 2016; see page 8 of this report for more details of how these estimates were derived.
[13] Source: http://smartasset.com

with 584 jobs and approximately $38.7 million in annual labor income. Table 5 highlights these results in detail.[14]

Table 5 – Annual Total Permanent Economic Impact of Pipeline O&M

	Direct Impact	Indirect Effect	Induced Effect	Total Impact
Employment	191	175	218	584
Labor Income	$20.6M	$8.8M	$9.3M	$38.7M
Gross Regional Product (GSP)	$22.9M	$18.1M	$17.5M	$58.5M

A comparison of the construction and O&M impacts in Tables 1 and 5 shows that the latter generates fewer jobs, but relatively more labor income. This is consistent with the findings of IHS Economics that suggest that the annual wage levels of workers operating and maintaining pipelines is higher than for workers building them. These results are broken down at the state level and by major industry sector in Tables 6 and 7.

Table 6 – Annual Total Permanent Economic Impact of Pipeline O&M by State

	South Carolina	North Carolina	Georgia
Employment	119	244	221
Labor Income	$8.5M	$17.7M	$12.5M
Gross Regional Product (GRP)	$14.3M	$27.2M	$17.0M

Table 7 – Total Economic Impact of Pipeline O&M in Tri-State Region
Top Industrial Sectors

Industry Sector	Total Employment	Total Labor Income	Total Gross Regional Product
Transportation and Warehousing	211	$23.0M	$34.1M
Administrative and Waste Services	55	$1.8M	$1.8M
Prof. Svs. & Mgmt. of Companies	55	$3.4M	$2.8M
Wholesale and Retail Trade	50	$1.9M	$2.6M
Construction	35	$1.6M	$1.8M
Health and Social Services	30	$1.8M	$1.5M
Accommodations and Food Svs.	30	$0.6M	$0.7M

[14] The results in Table 5 were calculated under the assumption that O&M direct employment figures primarily reflect NAICS sector 486910.

Industry Sector	Total Employment	Total Labor Income	Total Gross Regional Product
Other Services	25	$0.8M	$0.7M
Finance and Insurance	20	$1.1M	$1.2M
Real Estate and Rental	20	$0.4M	$3.3M

Section V – Economic Impact: Minimizing Supply Disruptions

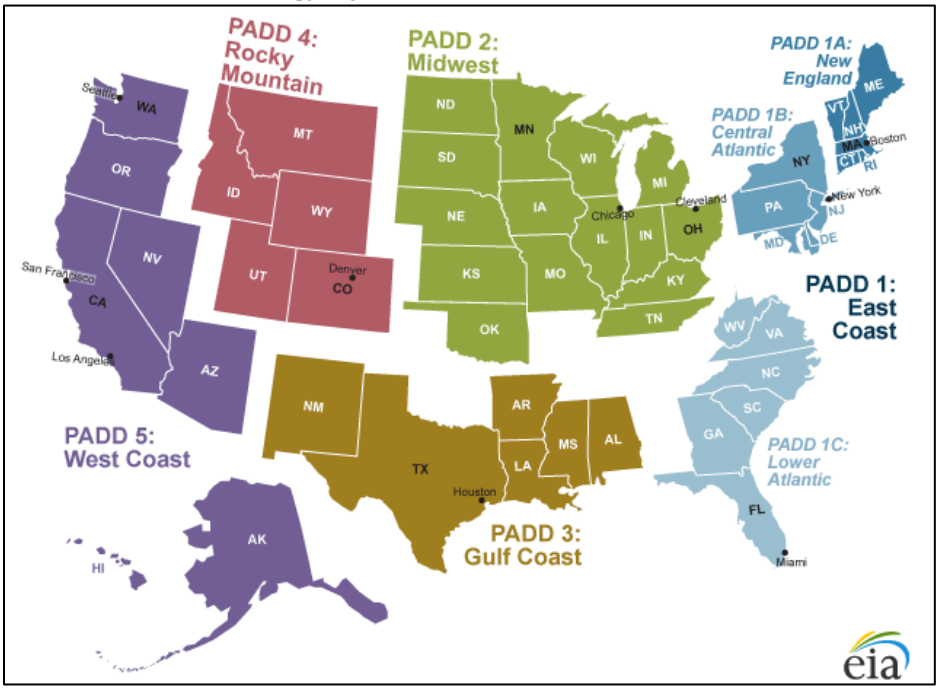
One of the major long-run economic benefits that can arise from maintaining adequate pipeline infrastructure is represented by the losses that could be *avoided* during periodic supply constraints resulting from major pipeline disruptions that lead to gasoline price increases. For example, Hurricanes Katrina (2005), Harvey (2017), and Irma (2017) all created supply disruptions involving the existing pipeline infrastructure that led to temporary decreases in the availability of petroleum products in South Carolina, North Carolina, and Georgia. The decrease in supply led to a sizable increase in the price of petroleum products, which in turn generated a net economic loss for the tri-state region resulting from a net reduction in consumer purchases due to higher prices.

Although it cannot be known for certain whether additional pipeline infrastructure would have definitively prevented the supply constraints associated with these three specific hurricane events, maintaining an adequate pipeline infrastructure in the tri-state region would nevertheless have the potential to help similar future supply disruptions from generating such large negative effects on the region's economy. The economic losses that could possibly be avoided as a result of maintaining pipeline infrastructure needs is the third set of economic impacts to be documented in this report. This section specifically estimates the economic losses that may have been avoided in 2005 and 2017 if the petroleum supply to South Carolina, North Carolina, and Georgia had not been affected by Hurricanes Katrina, Harvey, and Irma.

Modeling Assumptions

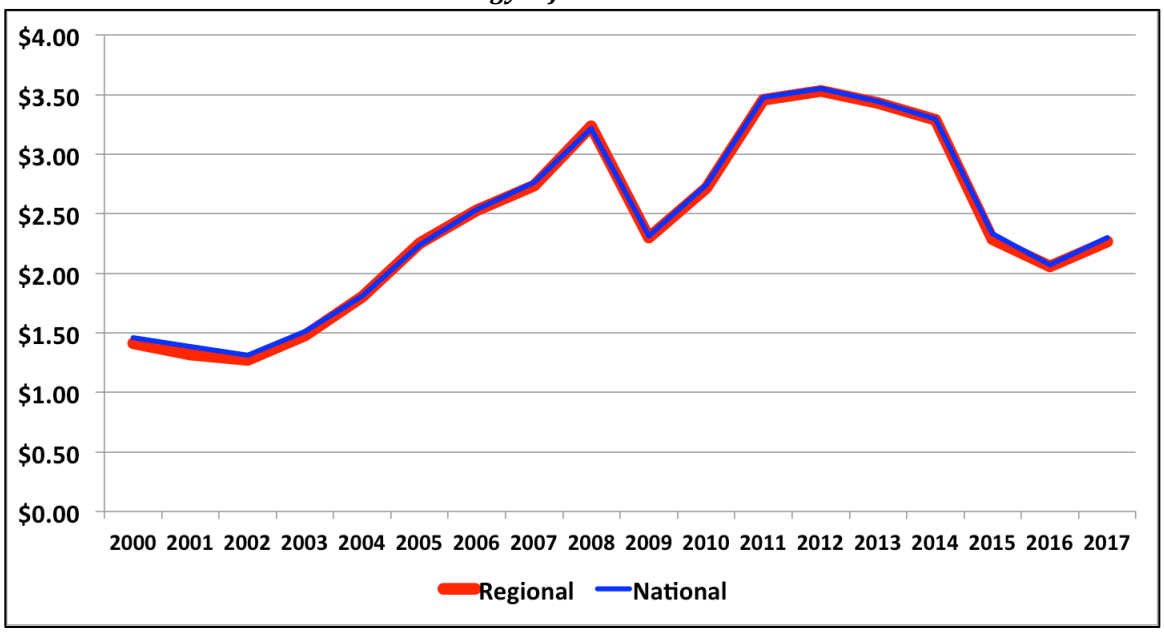
In order to estimate the economic impacts on the tri-state region resulting from a major supply disruption, historical data were first collected from the EIA on regional and national retail gasoline prices. Regional and national gasoline prices reflect the average price as reported by the EIA for the Lower Atlantic PADD 1C and for the U.S. as a whole, respectively. Figure 2 shows the states covered by each PADD (Petroleum Administration for Defense Districts) region.

Figure 2 – States by PADD for Retail Motor Gasoline
Source: U.S. Energy Information Administration, Form EIA-878



Trends in Lower Atlantic regional gasoline prices closely align to those of national gas prices, with regional prices averaging approximately two cents lower per gallon over the past 17 years. As Figure 3 displays, gasoline prices in the U.S. have risen from an average price of $1.46 per gallon in 2000 to $2.30 per gallon by September 2017.

Figure 3 – Lower Atlantic and National Gasoline Prices: 2000-2017
Source: U.S. Energy Information Administration



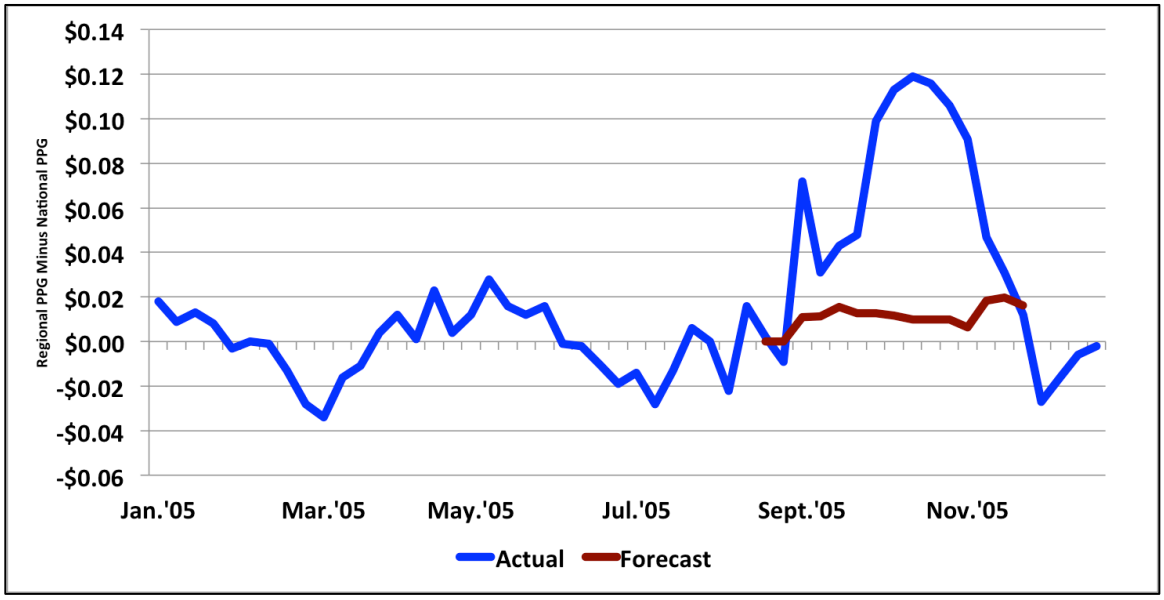
Because of the close parallels between national and regional price trends, this study estimates the effects of a regional supply disruption by examining the extent to which the difference between regional and national gasoline prices change. In other words, is there evidence that the difference between regional and national gasoline prices change during an event that causes a major disruption in supply? As outlined above, two case studies are examined: pricing changes following supply disruptions due to Hurricane Katrina in August 2005 and pricing changes following supply disruptions due to Hurricanes Harvey and Irma in August 2017.

Case Study 1: Hurricane Katrina

After originating in the Bahamas on August 23, 2005, Katrina strengthened to a category 5 hurricane and subsequently caused severe destruction along the Gulf Coast from central Florida to Texas over the course of approximately one week. One of the many effects of this storm was to disrupt the petroleum supply to the east coast of the United States, including to South Carolina, North Carolina, Georgia, and the entire Lower Atlantic region covered by PADD 1C. This supply constraint, in turn, generated a significant short-run price increase that can be observed in Figure 4. Specifically, Figure 4 illustrates both the actual difference between regional and

national gasoline prices during 2005 as well as forecasted values for the difference between regional and national prices from August 30, 2005 through December 31, 2005. These forecasted values are based upon historical data and thus estimate the likely price differences that would have emerged during the final four months of 2005 if Hurricane Katrina had never existed.[15]

Figure 4 – Regional vs. National Gasoline Prices: Jan.'05– Dec.'05
Note: Shown as Price Per Gallon (PPG)



A review of Figure 4 clearly shows the sizable increase in relative prices from September to November of 2005 in the aftermath of Hurricane Katrina. The average price per gallon of gasoline in the Lower Atlantic region averaged one cent less than that of the U.S. in August, but climbed to eleven cents higher than that of the U.S. by October (totaling a twelve cent price swing) before falling again to the national average by December. Table 8 summarizes these monthly changes and then compares them to the forecasted values. Although there is some variation in relative gasoline prices every year, the twelve-cent price spike is highly unusual and thus is more likely attributable to Hurricane Katrina.

[15] Forecasted values are based upon an autoregressive integrated moving average (ARIMA) model with seasonal controls using k-fold cross validation (k=10) to optimize model specification.

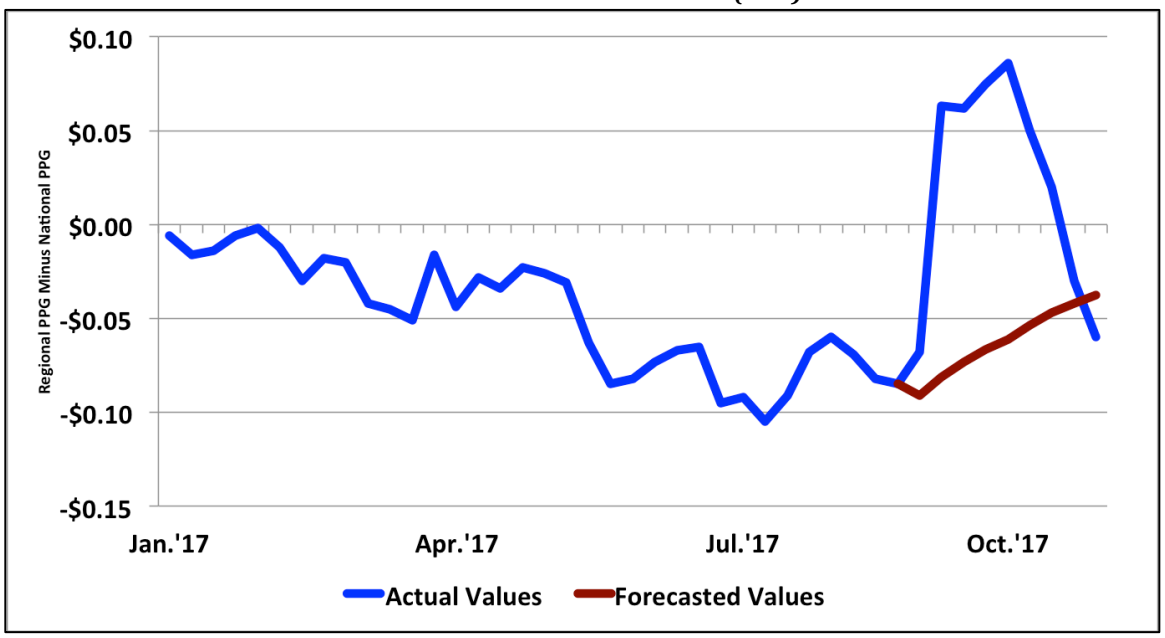
Table 8 – Gasoline Price Differentials in 2005: Regional Less National

Date (Month)	Price Differential (Actual)	Price Differential (Forecast)	Net Price Impact
Aug. 2005	-$0.01	+$0.00	-$0.01
Sept. 2005	+$0.05	+$0.01	+$0.04
Oct. 2005	+$0.11	+$0.01	+$0.10
Nov. 2005	+$0.01	+$0.02	-$0.01
Dec. 2005	+$0.00	+$0.03	-$0.03

Case Study 2: Hurricanes Harvey and Irma

Harvey and Irma were two category 4 hurricanes that both struck the eastern United States within the span of approximately two weeks during late August and early September of 2017. As with Katrina in 2005, one of the effects of Harvey and Irma was to disrupt the petroleum supply to the east coast of the United States, generating a significant short-run price increase. Figure 5 highlights the actual difference between regional and national gasoline prices during 2017 as well as forecasted values for the differences between regional national prices from August 21, 2017 to October 23, 2017. Once again, these forecasted values are based upon historical data and thus should be interpreted as the likely price differences that would have emerged between August and October of 2017 if Hurricanes Harvey and Irma had never existed.

Figure 5 – Regional vs. National Gasoline Prices: Jan.'17 – Oct.'17
Note: Shown as Price Per Gallon (PPG)



Just as Figure 4 shows a clear relative price increase following Hurricane Katrina in 2005, so too does Figure 5 show a relative price increase following Hurricanes Harvey and Irma in August and September of 2017. The average price per gallon of gasoline in the Lower Atlantic region averaged seven cents less than that of the U.S. on August 28, but climbed to nine cents higher than that of the U.S. by September 25 (totaling a sixteen cent price swing). As of October 23, region prices had returned to six cents less than that of the U.S. average. Table 9 summarizes these monthly changes and then compares them to the forecasted values. As with Hurricane Katrina, examining data from August to October reveals a unique price increase in 2017 that is likely attributable to Hurricanes Harvey and Irma.

Table 9 – Gasoline Price Differentials in 2017: Regional Less National

Date (Week)	Price Differential (Actual)	Price Differential (Forecast)	Net Price Impact
8/28/17	-$0.07	-$0.07	$0.00
9/4/17	+$0.06	-$0.08	+$0.14
9/11/17	+$0.06	-$0.07	+$0.13
9/18/17	+$0.08	-$0.07	+$0.15
9/25/17	+$0.09	-$0.05	+$0.13

Date (Week)	Price Differential (Actual)	Price Differential (Forecast)	Net Price Impact
10/2/17	+$0.05	-$0.05	+$0.10
10/9/17	+$0.02	-$0.05	+$0.07
10/16/17	-$0.03	-$0.04	+$0.01
10/23/17	-$0.06	-$0.04	-$0.02

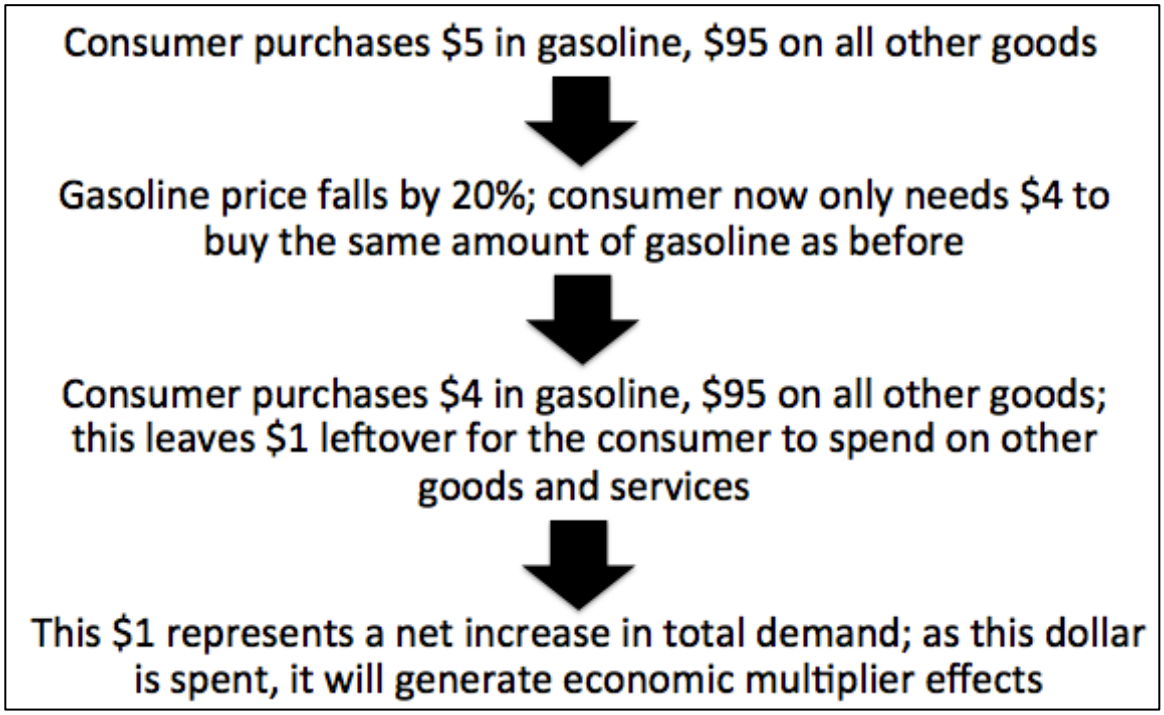
Primary Results

For each case study, Figures 4 and 5 highlight both the actual price differentials during the aftermath of the petroleum supply disruption as well as the forecasted price differentials that are assumed to have been the most likely alternatives in the event that the aforementioned hurricanes had not struck the U.S. In order to determine the total economic losses that could have possibly been avoided without a gasoline supply constraint, data on daily total gasoline consumption in the tri-state region was first obtained from the EIA. The difference between the actual price per gallon and the forecasted price per gallon during each month of the supply disruption (denoted "Net Price Impact" in Tables 8 and 9) was then applied to each month's consumption volume during the hurricane aftermath in each case study to estimate the potential savings to consumers that would have occurred if there had been no supply constraint. These savings to consumers represent the *direct effect* resulting from minimizing supply disruptions.

These direct effects, in turn, lead to additional benefits that arise through the economic multiplier effect. When gasoline prices decrease, consumers have the ability to purchase the same volume of gasoline at a lower price. This means that they will have extra money that is now "leftover" and can be used to purchase other goods and services. For example, consider a consumer who typically spends $100 in the tri-state economy - $5 of which is spent on gasoline. If the price of gasoline decreases such that only $4 is now needed to purchase the same amount of gasoline as before, the consumer will now have the ability to purchase the same $100 of goods and services in the tri-state region for only $99. The extra $1 can then be

spent elsewhere, as Figure 6 illustrates. In this example, the extra $1 being spent in the local economy represents the *direct effect,* while any subsequent rounds of spending that result from this initial wave of economic activity represents the *multiplier effect.*

Figure 6 – How a Price Decrease in Gasoline Can Generate a Net Gain in Economic Activity



Tables 10 and 11 summarize all estimates on the total economic losses that were sustained during the aftermath of Hurricanes Katrina, Harvey, and Irma and could potentially have been avoided if there had been increased petroleum pipeline infrastructure in South Carolina, North Carolina, and Georgia. In the two months following Hurricane Katrina, gasoline consumption in the tri-state region averaged 29.9 million gallons per day. The supply shortage during this period was estimated to have generated $126.6 million in losses to consumers – that is – consumers in the tri-state region spent $126.6 million more in gasoline because of the increased price per gallon that resulted from supply constraints. These direct losses, in turn, led to

an approximately $113.5 million loss in regional GDP.[16] These estimates reflect the total economic losses to the tri-state region that could likely have been prevented had additional pipeline infrastructure been in place during Hurricane Katrina.

Table 10 – Total Economic Impact of Minimizing Supply Disruptions: Hurricane Katrina

Metric	Tri-State	S.C.	N.C.	Georgia
Gasoline Consumption (9/2005-10/2005)	29.9M gallons/day	6.2M gallons/day	11.1M gallons/day	12.6M gallons/day
Total Gasoline Savings	$126.6M	$26.3M	$46.9M	$53.4M
---	---	---	---	---
Gross Regional Product (GRP)	$113.5M	$21.8M	$41.8M	$49.9M

Similarly, the average gasoline consumption that occurred between August and October 2017 was approximately 35.1 million gallons per day. The supply shortage during this period resulting from Hurricanes Harvey and Irma was estimated to have generated $431.9 million in losses to consumers – that is – consumers spent $431.9 million more in gasoline because of the increased price per gallon that resulted from supply constraints. These direct losses, in turn, led to an approximately $387.2 million loss in regional GDP. These estimates reflect the total economic losses to the tri-state region that could likely be avoided by having additional pipeline infrastructure in place during events like Hurricanes Harvey and Irma.

Table 11 – Total Economic Impact of Minimizing Supply Disruptions: Hurricanes Harvey & Irma

Metric	Tri-State	S.C.	N.C.	Georgia
Gasoline Consumption (8/2017-10/2017)	31.5M gallons/day	7.6M gallons/day	13.1M gallons/day	14.4M gallons/day
Total Gasoline Savings	$431.9M	$94.1M	$160.6M	$177.2M
---	---	---	---	---
Gross Regional Product (GRP)	$387.2M	$78.0M	$143.3M	$165.9M

[16] The estimated loss to regional GDP is less than the total increase in consumer spending on gasoline because a portion of these consumer dollars would have otherwise been spent outside of the tri-state region.

Section VI – Conclusion

This study has estimated the potential economic impacts that would likely emerge if a new, refined petroleum products pipeline were to be constructed and operated within the tri-state region of South Carolina, North Carolina, and Georgia. These estimates include both the impacts of construction and operations as well as the implications of cost savings to consumers in the form of lower gasoline prices that could possibly result from a permanent increase in petroleum supply to the Southeastern United States.

Specifically, this study has found that the construction of a hypothetical pipeline that is comparable to the existing Colonial and Plantation pipelines in the tri-state region would likely be 27 inches in length and span at least 620 miles across South Carolina, North Carolina, and Georgia. The construction of such a pipeline would, in turn, generate a total of $310.2 million in regional GDP. Additionally, it would support a total of 4,566 temporary jobs during the construction phase, of which approximately 2,763 would be on-site construction and construction-related positions. These 4,566 jobs would be associated with over $192 million in new labor income that would not exist otherwise. Upon completion of the pipeline, the ongoing operations and maintenance would generate a permanent increase in regional GDP of approximately $58.5 million annually, including 584 jobs and $38.7 million in labor income. To the extent that an actual pipeline route would be longer or shorter, benefits would be roughly proportional to the length.

Additional pipeline infrastructure also has the benefit of increasing the supply of petroleum to the Southeast and to the tri-state region, thus helping to minimize supply disruptions – including those that occur during major weather events. Since 2005, for example, Hurricanes Katrina, Harvey, and Irma have each caused significant temporary disruptions to the supply of petroleum in the tri-state region. In 2005, Hurricane Katrina helped to cause a temporary 12-cent per gallon increase in gasoline prices in the tri-state region relative to the national average, while

Hurricanes Harvey and Irma helped cause a temporary 16-cent per gallon increase in 2017.

This study estimates the size of the losses that could potentially be avoided through additional pipeline infrastructure. The aforementioned pricing disruptions are found to have generated a total of $114 million and $387 million in lost GDP to the tri-state region in 2005 and 2017, respectively. These losses include both the direct losses to consumers as well as all losses arising from economic multiplier effects associated with decreased regional demand resulting from a lower volume of consumer spending activity. Maintaining adequate pipeline infrastructure in the tri-state region would help any future supply disruptions from generating such large negative effects on the region's economy.

As the demand for energy and for refined petroleum products continues to increase in the Southeastern U.S. in the coming years, it will be important to consider the effects this increase will have on petroleum prices and on consumers in South Carolina, North Carolina, and Georgia. Maintaining an appropriate level of pipeline infrastructure has the potential to help meet increases in petroleum demand while simultaneously generating significant gains for the tri-state region by creating jobs and incomes and by minimizing supply disruptions – that is – allowing the region to meet an increase in demand for energy without an accompanying increase in price for the average consumer. This, in turn, will help to keep energy affordable for the foreseeable future as the Southeastern U.S. continues to help drive the nation's economic growth.