Energy in Pennsylvania: Past, Present, and Future

Submitted by:
Commonwealth Economics, LLC

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Commonwealth of Pennsylvania
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Introduction

In 1859, Edwin L. ("Colonel") Drake helped dig the world's first petroleum well in Titusville, Pennsylvania, often labeled "The Valley that Changed the World". That claim is not exaggerated. But well before that significant event in global and U.S. history, Pennsylvania had already established itself as the vanguard of energy production. According to the Pennsylvania Geological Survey, the earliest mention of coal in Pennsylvania appeared on a map made by John Pattin around 1752. The map indicates coal along the Kiskiminetas River a few miles below Saltsburg on the Indiana-Westmoreland County line. The earliest record of actual coal mining in Pennsylvania is indicated on a "Plan of Fort Pitt and Parts Adjacent" in 1761, 15 years before the Declaration of Independence. Fort Pitt was in what is now downtown Pittsburgh. Since that time, Pennsylvania has played a central role in America's energy sector.

That pivotal role continues today in the form of natural gas production, innovations in conservation, and along many other dimensions. The Commonwealth has already proven itself to be a national leader in environmental sustainability. Pennsylvania has historically been a leader in fossil fuel and nuclear energy production and is rapidly becoming a leader in natural gas production largely due to shale gas. Pennsylvania is the second state behind California to deregulate electricity and gas, is home to the first wind-powered county in the nation, and was the first state to purchase renewable energy. It is also the country's leading exporter of electricity.

Further, Pennsylvania has one of the most ambitious solar provisions in the Eastern United States and was ranked fifth among all states in terms of its commitment to and achievements in the field of energy efficiency by the Center for American Progress. It has also made tremendous progress in the use of renewable energy and implementation of energy efficient technologies in the past decade.

In light of the massive shifts in energy production and consumption and the significant economic and fiscal implications of these shifts, the Commonwealth of Pennsylvania, Department of Environmental Protection through the Pollution Prevention and Energy Assistance Office sponsored and oversaw the production of this comprehensive energy analysis. The study was commissioned for two reasons – one broad and social – the other strategic and programmatic. This report is intended to serve as a statistical foundation for Governor Tom Corbett's upcoming strategic State Energy Plan, which will assist in the development of policy and to provide justification for energy-related investments.

The study team has provided data regarding energy production and energy utilization by key use sectors including transportation, commercial, industrial, and residential. The data are also provided to the extent possible on a regional basis, including both metropolitan and rural areas. Finally, there is a substantial volume of data regarding potential energy production by energy source and by geography within the state. The study team, comprised of researchers from Harrisburg-based Commonwealth Economics LLC, has also developed accompanying narrative to support a greater understanding of the data, observed trends and their economic and social significance.

Executive Summary

Purpose of Study

This report provides policymakers, energy producers, interested consumers and other stakeholders with statistical detail regarding energy production and consumption in the Commonwealth. To the extent possible, data have been gathered from local sources, though the reader will also find information from national sources as well. Trend data regarding production, pricing, market share by energy type and geographical patterns are supplied throughout the document.

The study team has also provided supporting narrative that works in conjunction with the report's graphs and tables. Though there has been no effort to editorialize or to favor one form of energy over another or one policy over another, the report endeavors to provide insight regarding causal factors underlying trends in production, consumption and conservation. There is also detailed information comparing consumption and production patterns in Pennsylvania vis-à-vis the balance of the Mid-Atlantic region and the nation.

The report is organized into six chapters. It endeavors to be a statistical abstract regarding energy production and consumption in Pennsylvania. To the extent possible, information has been organized to allow the reader to locate specific information quickly, whether regarding coal production, electricity generation, natural gas prices, the number of jobs supported by a particular form of activity or consumption per capita. The central message of this report is that Pennsylvania is making faster progress toward closing its gap between energy production and consumption than most American states. This pattern of rising production and slowing consumption is expected to continue over time, eventually allowing Pennsylvania and the nation to declare energy independence.

Select Key Analytical Findings by Chapter

Chapter 1: Energy Consumption

This chapter examines energy consumption, expenditures, and prices over time.

- In 2010 the distribution of total energy consumption by sector was as follows: electric power (37.6%); industrial (18.8%); transportation (16.5%); residential (15.7%); commercial (11.4%);
- In 2010 the distribution of energy consumption by fuel type was as follows: coal (29.4%); petroleum (29.5%); natural gas (20%); nuclear (18.3%); renewables (2.8%);
- During the 2000-2017 period, total energy consumption is expected to decrease from 3,928 trillion BTU in 2000 to 3,759 trillion BTU in 2017 (-4.3%). Peak consumption occurred in 2005 when 4,022 trillion BTU were consumed in Pennsylvania, the only time when annual consumption exceeded 4,000 trillion BTU; and
- The total price for energy (i.e. the weighted average price for all fuels consumed by all users) in Pennsylvania grew 6.3 percent over the 2000-2010 period. Between 2000 and 2017, coal, the least expensive of these fuels, is projected to have the highest average annual growth rate

in its price (5 percent). Natural gas and retail electricity are expected to increase at much more modest rates, 0.8 percent and 1.3 percent, respectively.

Chapter 2: Energy Production

Pennsylvania benefits from a remarkably broad array of primary energy resources in the form of coal, crude oil, and natural gas. This chapter catalogues the availability of these resources and also provides statistical detail regarding alternative energy potential.

- Coal production, which has been in decline since 2000, is expected to continue that decline until at least 2017 and probably beyond. While there are expected to be some year-to-year variations, production is expected to fall by more than one-quarter from 2000 to 2017;
- The advent of Marcellus Shale-related production has had a dramatic impact on Pennsylvania's production levels, with production nearly tripling from 2008 to 2010. By 2017 Pennsylvania is expected to produce 1.2 trillion cubic feet of natural gas, almost eight times the volume produced in 2000. Over that same period, national production is expected to increase 27 percent;
- Pennsylvania-based production of crude oil is expected to rebound from recent declines reaching 4 million barrels in 2017 due in part to anticipated price dynamics; and
- Since 2008, Pennsylvania-based production in biodiesel has increased from an initial annual production of 25 million gallons to more than 40 million gallons in 2011. Production in the first six months of 2012 was more than 20 million gallons, a pace well above that of 2011.

Chapter 3: Electricity Generation

The mix of fuels used to produce electricity has shifted substantially in recent years and is anticipated to continue to shift. This chapter addresses the capacity for electricity generation in Pennsylvania, how much electricity is generated in the state, and how trends in production and consumption may change the makeup of the electricity market going forward.

- Pennsylvania ranks second in the U.S. in terms of electricity generation. It is also the number one exporter of electricity in the country
- Coal remains the dominant type of fuel used to produce electricity in Pennsylvania;
- Natural gas is projected to account for one-quarter of the electricity produced by 2017; and
- In 2000, renewable sources contributed an estimated 5.0 million megawatt hours of electricity generation in Pennsylvania. By 2011, the volume of electricity generated by renewable sources increased to 7.4 million megawatt hours. This growth is more substantial than in any of Pennsylvania's neighboring states.

Chapter 4: Imports and Exports

This chapter focuses on juxtaposing state-based production and consumption in significant categories, including natural gas, coal, electricity, and crude oil. The chapter highlights both categories in which Pennsylvania is a net exporter and a net importer.

- Pennsylvania is a net exporter of natural gas, coal, and electricity. However, like most states, Pennsylvania is a net importer of petroleum products, rendering it a net importer of energy in the aggregate; and

- Although Pennsylvania and neighboring states are all net energy importers, Pennsylvania stands out as having reduced its energy deficit more dramatically than the other states, primarily due to Marcellus Shale production.

Chapter 5: Energy Efficiency, Conservation, and Innovation

This chapter discusses initiatives that the Commonwealth of Pennsylvania has implemented to engender more efficient use of energy as well as opportunities to promote additional progress along the dimension of energy efficiency.

- In 2008, Pennsylvania passed Act 129 that expanded the responsibilities of the Pennsylvania Public Utility Commission (PUC) and added new requirements for the state's larger electric distribution companies (EDCs) in the areas of energy efficiency and conservation; and
- Examples of technologies Pennsylvania has pursued to increase energy efficiency and conservation include distributed and dispersed generation, advanced metering, smart grids, and renewable and alternative energy supply option programs.

Chapter 6: Energy and Energy-related Infrastructure and Industry

This chapter discusses electricity market dynamics in Pennsylvania, state of infrastructure and obstacles to more efficient energy production and distribution.

- Pennsylvania's pipeline infrastructure is expected to increase capacity significantly as natural gas production continues in Marcellus, Utica, and other unconventional shale formations;
- The development of new gathering pipelines is expected to accelerate to connect drilling sites with the larger network of interstate/intrastate pipelines. It is estimated that anywhere from 500 to 1,250 miles of gathering pipeline will be needed over the 20-year period from 2010 to 2030; and
- The impact of Marcellus Shale on pipeline infrastructure is apparent in pipeline capacity trends. Since 2000, pipeline flows in Pennsylvania have reversed from an inflow of 0.3 billion cubic feet per day (bcfd) to an outflow in 2011 estimated at 1.3 bcfd.

Conclusion

There are few if any industries as dynamic as energy. Both nationally and in Pennsylvania, production and consumption patterns are shifting, technologies are being diffused, and supportive public policies such as Act 129, Act 13, and Act 213, the Alternative Energy Portfolio Standards Act, are being developed. Though like most states Pennsylvania remains a net importer of energy, that status is unlikely to last indefinitely due to the rapid expansion of natural gas, renewable and other forms of energy production in the Commonwealth.

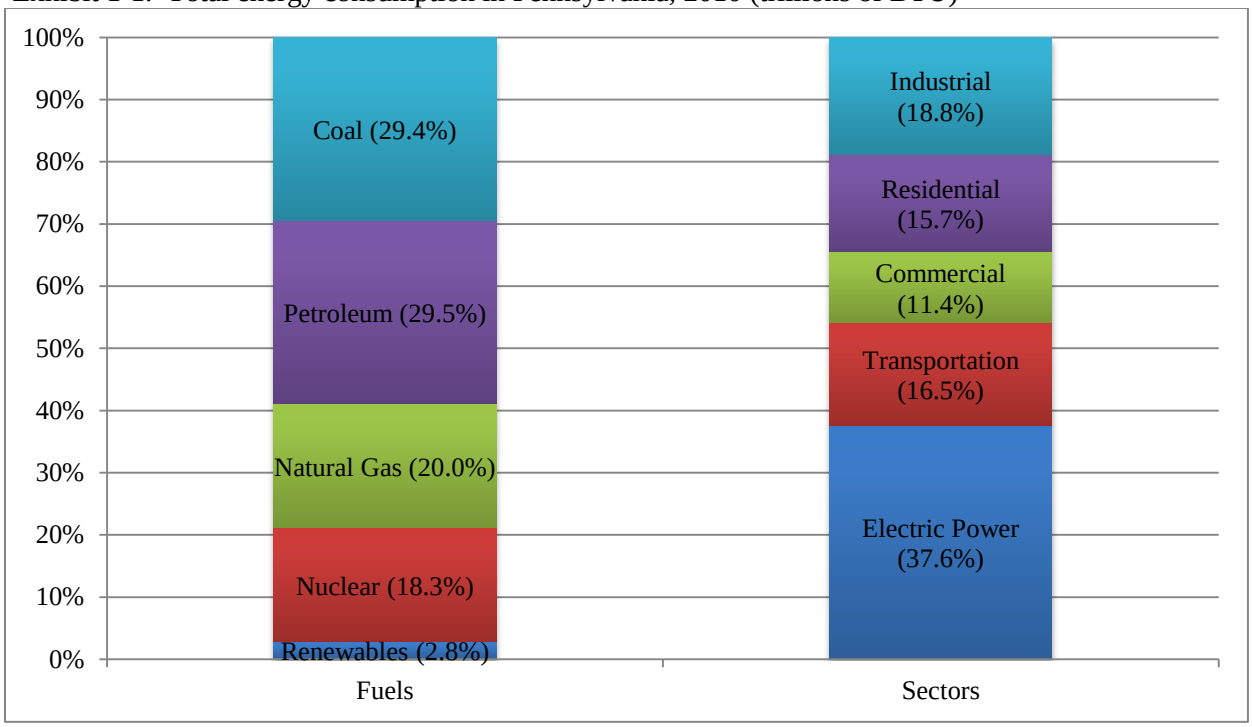
The implications of implementing forward-looking energy strategies in Pennsylvania are simply massive. Sound policy would promote greater energy exports, enhanced efficiency, an improved local and global environment, job creation, income formation and associated business development opportunities. This report serves as a foundational element to the strategies that will ultimately be developed, refined and implemented in the Commonwealth.

Energy in Pennsylvania: Past, Present, and Future

1.0 Energy Consumption

Energy consumption can be viewed from many perspectives. Total energy consumption measures consumption in terms of its heat value (measured in BTUs) and allows for the aggregation of consumption across different forms of energy (e.g., coal, electricity, natural gas). Exhibit 1-1 provides a summary of energy consumption in Pennsylvania by both fuel type and sector.

Exhibit 1-1. Total energy consumption in Pennsylvania, 2010 (trillions of BTU)



Source: Energy Information Administration
Note: Graph excludes electricity and electrical system losses

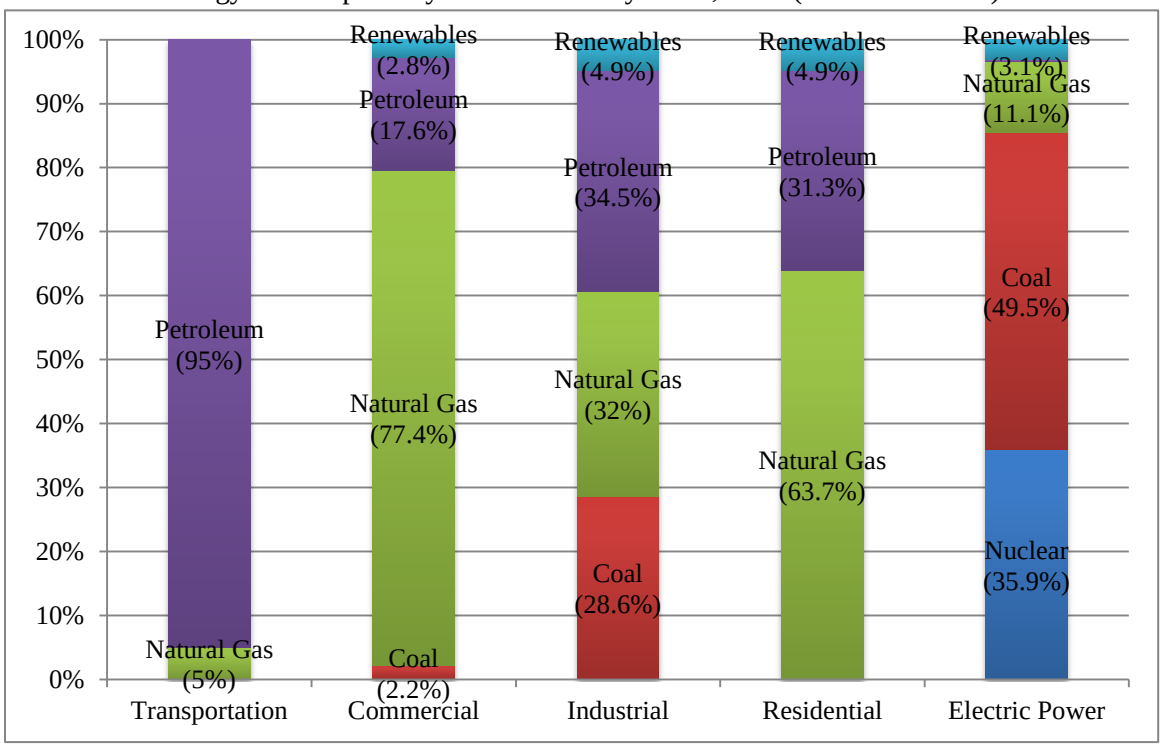
Expenditures for energy consumption can also be considered in terms of heat values or in terms of the typical units for specific energy types. Examining expenditure trends over time, particularly in relation to measured economic activity (e.g., gross domestic product), provides an overview of the economy's ability to wring more value from energy inputs.

Future consumption estimates presented below are generally based on projections from the most recent 2012 Annual Energy Outlook published by the Energy Information Administration (EIA), a division of the U.S. Department of Energy. In many cases, EIA projections are published at the national and regional level, but not at the state level. EIA therefore serves as the underlying data for much of the report and is both substantiated and supplemented by Pennsylvania-specific government and organizational sources.

1.1 Total Energy Consumption

Current energy consumption in Pennsylvania varies widely by sector. For example, petroleum usage dominates the transportation sector while natural gas consumption comprises more than half of the state's consumption in both the commercial and residential sectors. Exhibit 1-2 below provides a detailed breakdown of energy consumption by sector based on 2010 data.

Exhibit 1-2. Energy consumption by sector in Pennsylvania, 2010 (trillions of BTU)



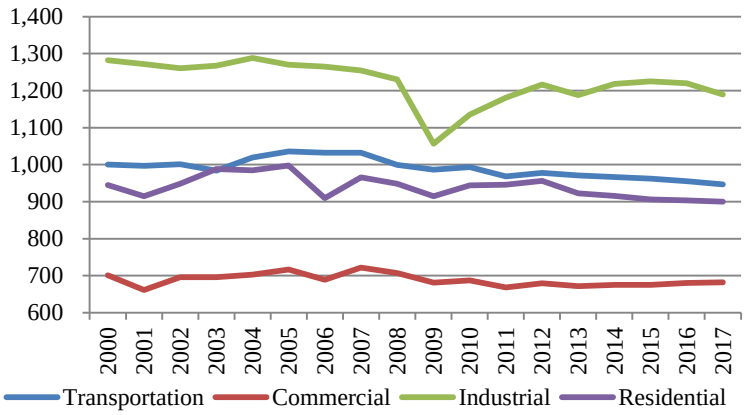
Source: Energy Information Administration
Note: Graph excludes electricity and electrical system losses

Between 2000 and 2017, total energy consumption in Pennsylvania is projected to fall at an average rate of 0.3 percent annually. Industrial consumption is anticipated to fall faster than other sectors (an average of 0.4% per year), while commercial consumption is expected to experience the smallest average decline over this 17-year period. Transportation and residential consumption are projected to decline, on average, at rates consistent with the overall state rate. These trends reflect a complex mix of shifting technologies (e.g., more energy efficient manufacturers, increasingly fuel efficient vehicles), consumer behavior and the impacts of public policy in striving to reduce energy utilization (e.g., green construction).

The most notable change in consumption was the sharp drop in industrial consumption in 2009 when total sector consumption dropped 14 percent from the prior year (1,230 trillion BTU in 2008 versus 1,056 trillion BTU in 2009). This drop in industrial energy use was coincident with

a significant reduction in employment in energy-intensive manufacturing industries in Pennsylvania and sharp declines in industrial production.[1] Other year-to-year changes have been or are projected to be more modest with all sectors tending to experience more consistent declines. See Exhibit 1-3 for additional statistical detail.

Exhibit 1-3. Total energy consumption trends for Pennsylvania (trillions of BTU)



	Average annual growth rate*
Transportation	-0.3%
Commercial	-0.2%
Industrial	-0.4%
Residential	-0.3%
Total	-0.3%

Note. Average annual growth rate is the average annual change for the total change in values over the period being addressed. The calculation of the average annual growth rate assumes that the calculated rate is compounded from year-to-year over the entire period.
Source: Energy Information Administration

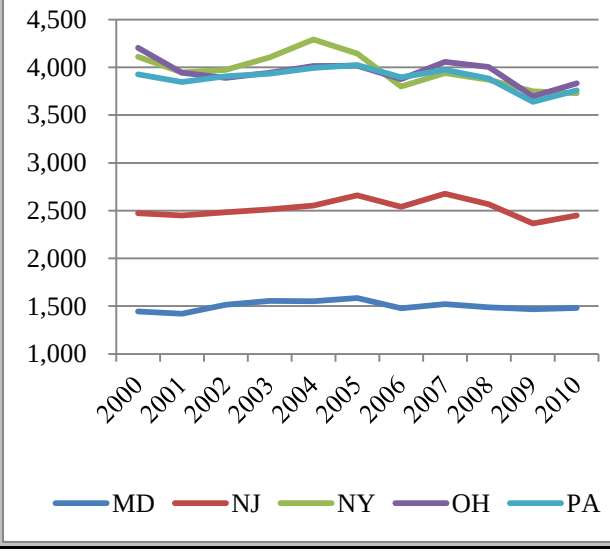
Historic total energy consumption in Pennsylvania closely tracked that of New York and Ohio while being substantially higher than New Jersey and Maryland. The latter two states have substantially smaller populations than Pennsylvania. Maryland is also largely oriented toward service sector as opposed to industrial activities.

Over the entire period, total energy consumption is expected to decrease from 3,928 trillion BTU in 2000 to 3,759 trillion BTU in 2017. Peak consumption in this period occurred in 2005 when 4,022 trillion BTU were consumed in Pennsylvania, the only time when annual consumption exceeded 4,000 trillion BTU. See Exhibit 1-4 for relevant statistical detail.

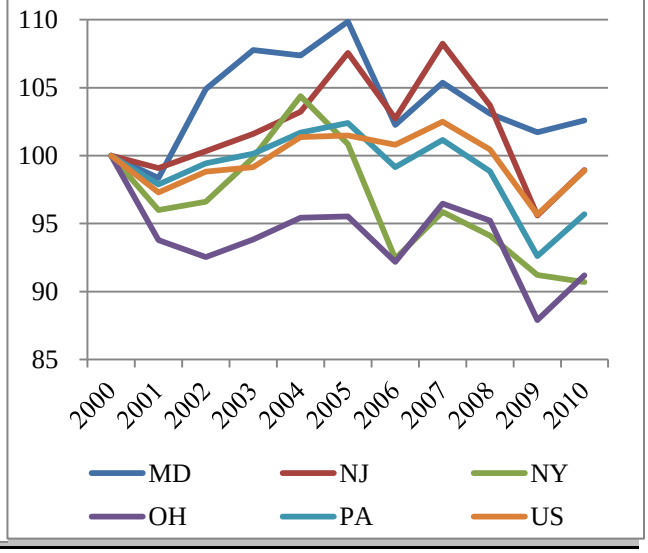
[1] See discussion of trends in employment in energy-intensive industry in Section 7. From 2008 to 2009, total employment in the selected energy-intensive industries in Pennsylvania decreased from 236,000 to 211,000, a loss of over 10 percent.

Exhibit 1-4. Total energy consumption trends

Pennsylvania and nearby states (trillions of BTU)



Pennsylvania, nearby states and US (indexed with 2000 = 100)[2]



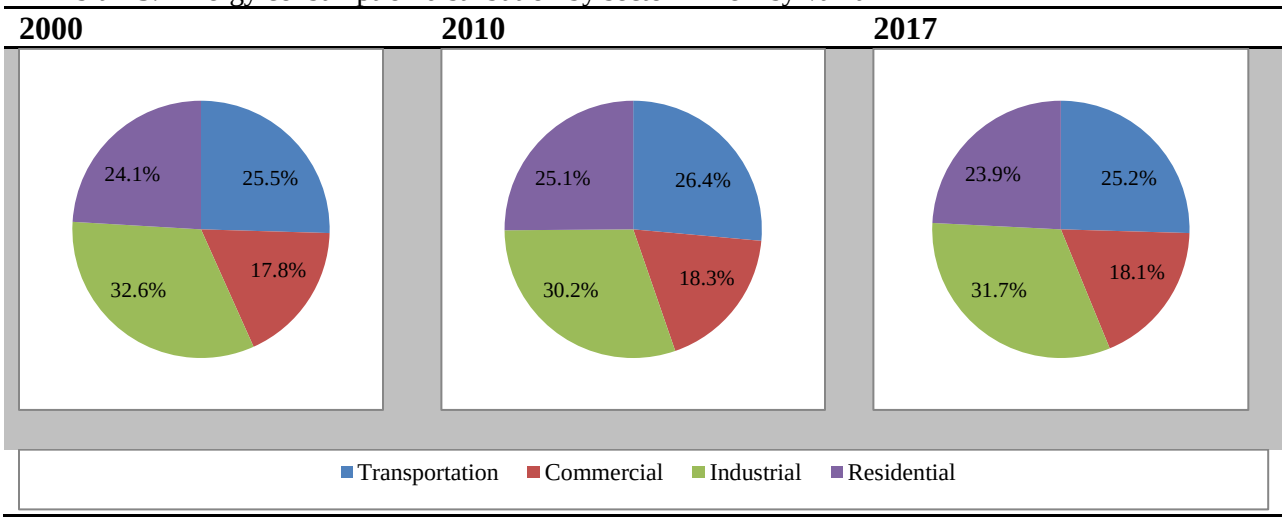
Source: Energy Information Administration

When indexed from a base of consumption in the year 2000 and from the perspective of conservation, Pennsylvania compares favorably to several of its neighboring states and the nation as a whole.[3] By 2010, total energy consumption in Pennsylvania was at 96 percent of its 2000 level. In 2010, New York and Ohio had reduced consumption to 91 percent of their 2000 totals, but New Jersey and the U.S. had barely dropped from their 2000 levels, while Maryland was consuming 3 percent more energy than it had in 2000 as shown in Exhibit 1-4. There are a number of potential explanations, the most likely of which is the impact of the recent recession on industry and other aspects of the Pennsylvania economy. It is worth noting that among the states of the Mid-Atlantic region, Maryland suffered the least in terms of rising unemployment and dislocated economic activity. Therefore, it is not surprising that it consumes relatively more electricity now as compared to prior years. Pennsylvania, home to many industrial activities, was more impacted by the national downturn in industrial production. However, there are other candidate explanations, including Pennsylvania's focus upon energy conservation.

[2] The indexing in this exhibit and many subsequent exhibits is designed to isolate relative performance for Pennsylvania and other states and the U.S. For this exhibit, the process of indexing sets Pennsylvania's energy consumption in 2000 to a value of 100. The value in each subsequent year is determined in relation to that initial value of 100. If, for example, energy consumption rises 10 percent relative to consumption in 2000, the index is set at 110. For the exhibit this process is used to set consumption in 2000 for all states shown in the exhibit and the U.S. to 100 and all subsequent values are determined in relation to this 2000 value of 100. The process of indexing allows direct comparisons of relative performance among these states despite the different levels of energy consumed.

[3] For this exhibit total consumption in 2000 for all jurisdictions is set at 100. Subsequent changes in consumption are measured relative to this base year.

Exhibit 1-5. Energy consumption distribution by sector in Pennsylvania



Source: Energy Information Administration

The distribution of consumption across sectors varies little over time. In 2000, as measured in BTUs, industrial activities represented the largest consumer of energy in all forms, accounting for 32.6 percent of total consumption, followed by transportation, residential, and commercial in that order.

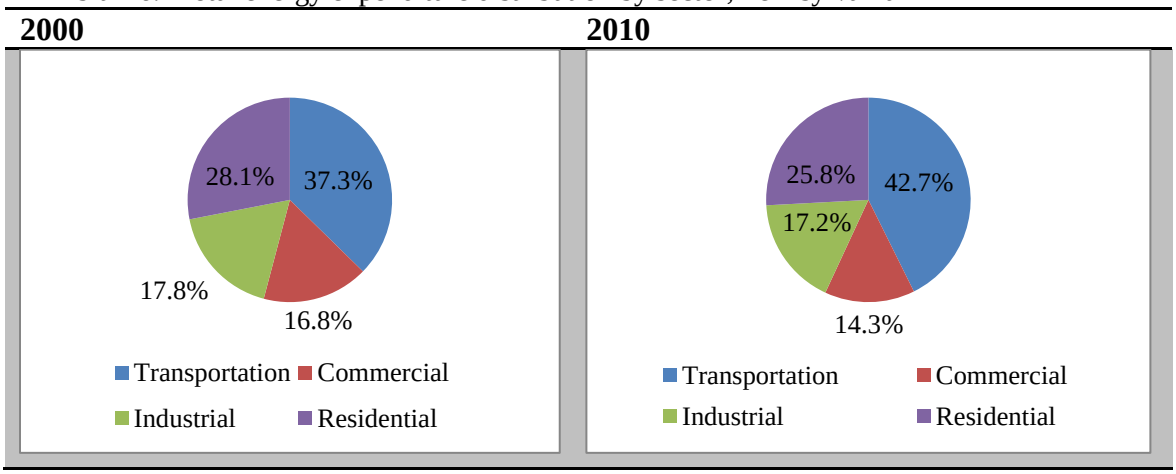
A decade later, the industrial sector was still the largest consumer of energy, but it consumed a significantly smaller share of total energy, while shares of all energy consumed by all other sectors grew. Part of this is attributable to the economic downturn. Much of the balance is the result of improving technology. Industry by its very nature tends to use considerable energy as the process of transforming inputs into differentiated outputs often involves complex chemical processes that require intense heat. By 2017, industrial is expected to account for a slightly larger share of total consumption relative to 2010 with all other sectors accounting for reduced shares. Though the efficiency of industry in terms of energy use per unit of output will continue to improve, there is an expectation that industry is positioned to expand its presence in the overall mix of Pennsylvania's economy going forward. Additional detail is provided in Exhibit 1-5.

When compared to other proximate states, Pennsylvania's energy consumption by sector matches most closely with Ohio and is similar to the distribution for the U.S. as a whole. Specifically, the industrial sector in Pennsylvania and Ohio accounts for a larger share of total energy consumption than in Maryland, New Jersey, and New York. Conversely, the transportation sector accounts for the smallest share in both states.

1.2 Total Energy Expenditures

Although industrial activities represent the largest consumer of energy, measured in BTUs, it comprises a relatively small share of total state energy expenditure. Interestingly, transportation accounted for more energy *expenditures* than any other sector in 2000 and again in 2010 when it increased its share of total energy expenditures to almost 43 percent from 37 percent ten years earlier. All other sectors accounted for smaller shares of total energy expenditures in 2010 compared to 2000. Exhibit 1-6 provides relevant detail.

Exhibit 1-6. Total energy expenditure distribution by sector, Pennsylvania



Source: Energy Information Administration

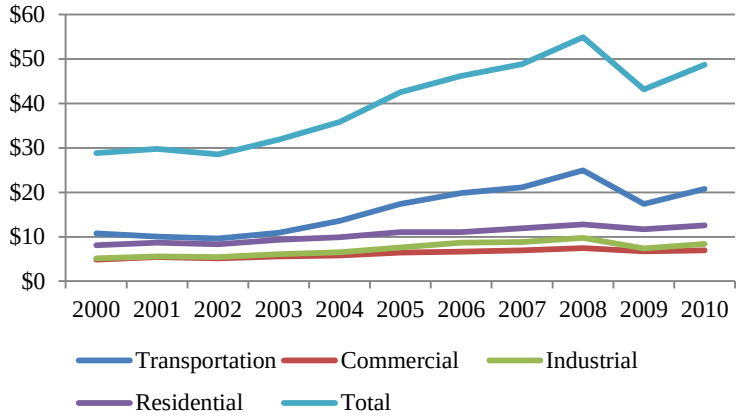
Over that decade, spending on all energy in the state increased by an average of 5.4 percent annually from $30 billion in 2000 to $50 billion in 2010. Energy expenditures in the transportation sector grew at an even faster rate (6.8 percent). And, in fact spending in this sector roughly doubled over the course of a decade, due in large measure to more expensive oil and petroleum prices. Remaining sectors registered average annual increases below the statewide rate with commercial, industrial, and residential energy expenditures growing at annual rates ranging from 3.7 percent to 5 percent. At least part of this is explained by the availability of relatively inexpensive natural gas for commercial, industrial and residential segments in recent years.

As the discussion above suggests, changes in total expenditures on energy are substantially affected by changes in energy prices. In current dollars, total energy prices increased by 84 percent from 2000 to 2010. Some forms of energy registered much lower increases. For example, retail electricity prices increased only 35 percent over the course of the decade. Petroleum prices more than doubled. Natural gas prices almost doubled between 2000 and 2008, but then dropped by a third from 2008 to 2010.

Trends for each sector are shown in Exhibit 1-7. Consistent increases in energy expenditures are shown across sectors from 2000 through 2008 when the recession began to take hold. Sharp

drops in expenditures from 2008 to 2009, particularly in transportation, reflect the drop in overall economic activity. Increases from 2009 to 2010 reflect improving economic conditions as Pennsylvania, along with the rest of the nation, began to pull out of the recent recession.

Exhibit 1-7. Total energy expenditure trends in Pennsylvania (billions of dollars)



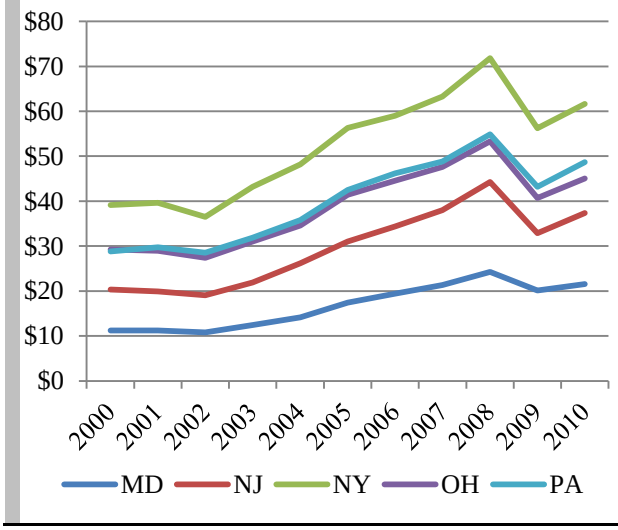
Average annual growth rate	
Transportation	6.8%
Commercial	3.7%
Industrial	5.0%
Residential	4.5%
Total	5.4%

Source: Energy Information Administration

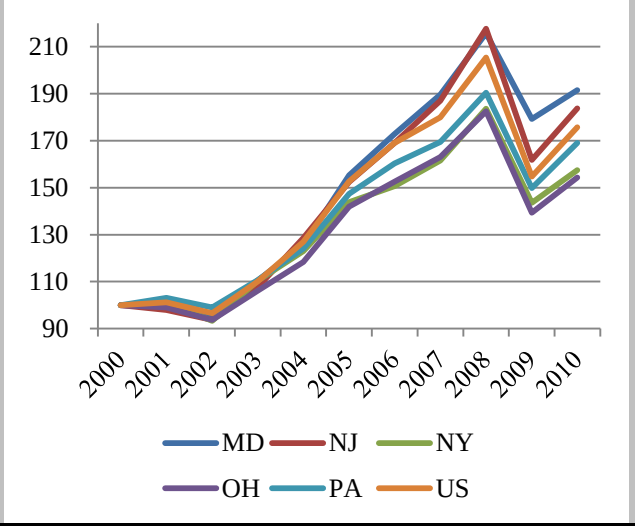
This pattern of increasing energy expenditures is observed in all states neighboring Pennsylvania. From 2000 to 2010, total expenditures for Pennsylvania and Ohio track extremely closely while New York consistently spent about $10 billion more than Pennsylvania. New Jersey spent about $10 billion less and Maryland about $20 billion less than Pennsylvania. See Exhibit 1-8.

Exhibit 1-8. Total energy expenditure trends

Pennsylvania and nearby states (billions of dollars)



Pennsylvania, nearby states and US (indexed with 2000 = 100)



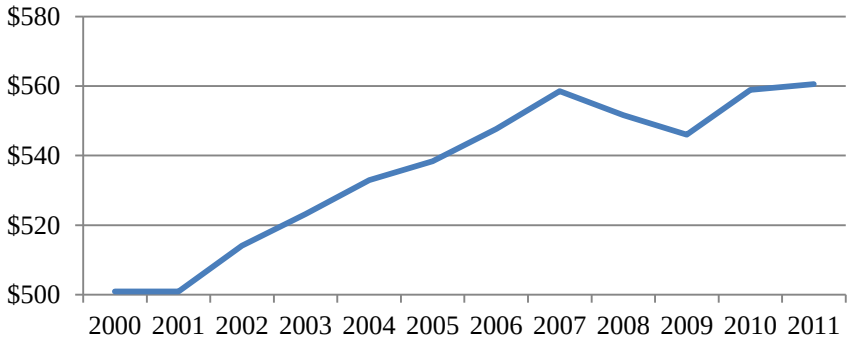
Source: Energy Information Administration

When energy expenditures from 2000 through 2010 are indexed, Pennsylvania performed well relative to the nation and in the middle of the pack with respect to surrounding states. This is reflected in Exhibit 1-8. From 2000 to 2010, Pennsylvania's total spending on energy increased 69 percent. This was higher than in New York (57 percent) and Ohio (54 percent). On the other hand, the nation as a whole increased energy spending by 76 percent with New Jersey increasing its spending by 84 percent and Maryland surging 92 percent. Again, this is at least partially a reflection of the disparate impact of the economic downturn on respective state economies. These changes in energy expenditures reflect the economic and demographic factors that influence energy consumption, noted above, and are compounded by energy prices that also vary from state to state.

1.3 Pennsylvania Gross Domestic Product and Energy Consumption

From 2000 to 2010, the state's economy grew an average rate of 1 percent per year in real terms (as measured in 2010 dollars). Over that decade the state's economy expanded by roughly $60 billion, measured in constant 2010 dollars.

Exhibit 1-9. State gross domestic product trends (billions of 2010 dollars), Pennsylvania



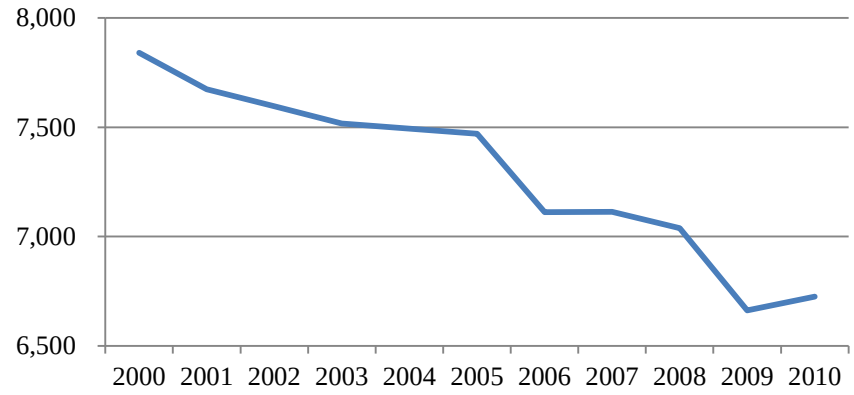
	Average annual growth rate
Pennsylvania state gross domestic product	1.0%

Source: Energy Information Administration

This expansion of the state's economy has come as the state's end-users of energy have on average made more efficient use of energy. In 2000, Pennsylvanians consumed almost 7,900 BTUs per dollar of gross domestic product. Ten years later, a dollar of gross domestic product required only about 6,700 BTUs. Over that 10-year period, energy consumption per dollar of state gross domestic product decreased an average of 1.5 percent each year.

This increasing efficiency represents a consistent pattern with one minor exception. From 2009 to 2010, there was a slight uptick in energy consumption relative to the state gross domestic product that occurred when the state was recovering from its recession. See Exhibit 1-10.

Exhibit 1-10. Energy consumption per dollar of state gross domestic product trends (BTUs per 2010 dollar), Pennsylvania



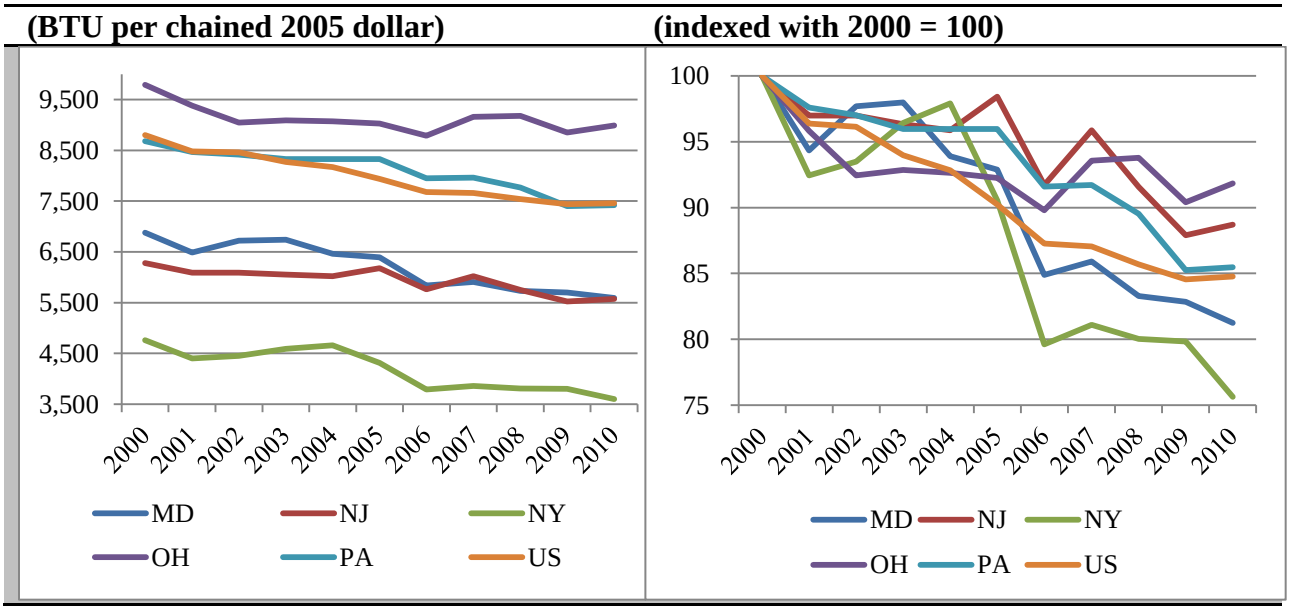
	Average annual growth rate
Total energy consumption per dollar of state gross domestic product	-1.5%

Source: Energy Information Administration

Increasing energy efficiency relative to economic output is a consistent pattern for nearby states and the U.S. Pennsylvania's experience closely tracked that of the U.S. as a whole. Ohio consistently used more energy per dollar of output, while other nearby states used less energy, particularly New York, which used roughly half the energy of the U.S. These patterns are likely a reflection of the energy intensity of the economic base of these states. See Exhibit 1-11. While these trends indicate a uniform ability to squeeze more economic output out of energy inputs, the disparities across states also reflect the differing economic natures of states. New York, for example, is traditionally associated with financial services, communications, and other industries that are much less energy intensive than the manufacturing that has traditionally anchored the economies of states like Pennsylvania and Ohio. The New York City region also makes more use of public transit than any other metropolitan region in the country.

When energy spending per dollar of gross domestic product is indexed, Pennsylvania's progress in energy efficiency from 2000 to 2010 is in the middle of the range of nearby states. Maryland and, especially, New York were able to reduce their relative needs for energy vis-à-vis economic output even faster than Pennsylvania while New Jersey and Ohio were less successful in their relative reduction of energy inputs per dollar of output. Over that decade, Pennsylvania's progress in energy efficiency relative to economic output was almost exactly that of the U.S. as a whole, which reduced energy use per dollar of output 15 percent from 2000 to 2010. See Exhibit 1-11.

Exhibit 1-11. Total energy consumed per dollar of real gross domestic product: Pennsylvania, nearby states and US



Source: Energy Information Administration

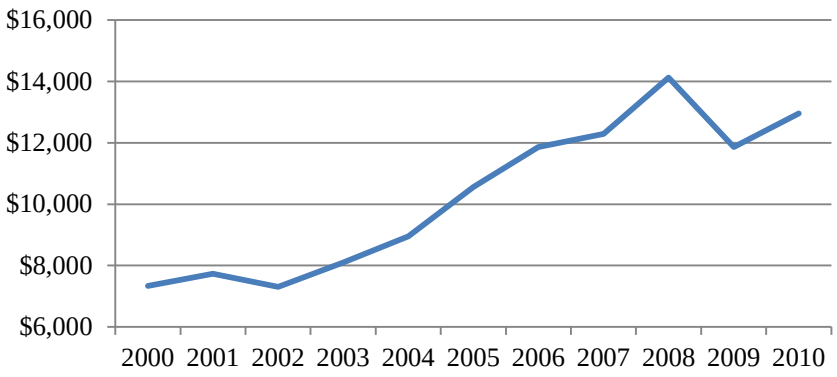
The increasingly efficient use of all forms of energy was strongly influenced by the increasing cost of energy in Pennsylvania over the 2000-2010 period. On average one billion BTUs of energy cost just over $7,000 in 2000 (in 2000 dollars). By 2010, that same billion BTUs cost $13,000 in 2010 dollars, an increase approaching 90 percent.[4] This easily outstripped the overall increase in consumer prices, which was in the range of 23 percent between 2000 and 2010 (CPI-U). With the exception of the recessionary period that lasted for much of the 2008-2009 period, this pattern of increasing energy costs was consistent throughout the 2000-2010 period. See Exhibit 1-12. This increase in energy costs observed and experienced in Pennsylvania was consistent with national experience.

The increasing cost of energy on a per unit basis more than offset the effects of enhanced energy efficiency. Correspondingly, the dollar value of energy inputs (i.e. what Pennsylvanians spent on energy to create the state's gross domestic product) as a share of the value of Pennsylvania's gross domestic product tended to increase year to year from 2000 to 2010. On average, energy expenses per dollar of Pennsylvania's economic output increased 1.8 percent per year from 2000 to 2010. Energy costs dropped substantially from about 10 percent in 2008 to 8 percent in 2009 due to the recession's impact on energy prices. A smaller downward shift occurred from 2001 to

[4] According to the U.S. Department of Commerce's Bureau of Economic Analysis, price inflation for the gross domestic product and all non-durable goods rose was 25 percent from 2000 to 2010, while price inflation for gasoline and other energy goods was 90 percent. See National Income and Product Accounts Tables, BEA, U.S. Department of Commerce. http://www.bea.gov/iTable/iTable.cfm?ReqID=9&step=1

2002, another period overlapping with national output declines. In every other year-to-year period, energy expenses as a share of economic output increased as reflected in Exhibit 1-13.

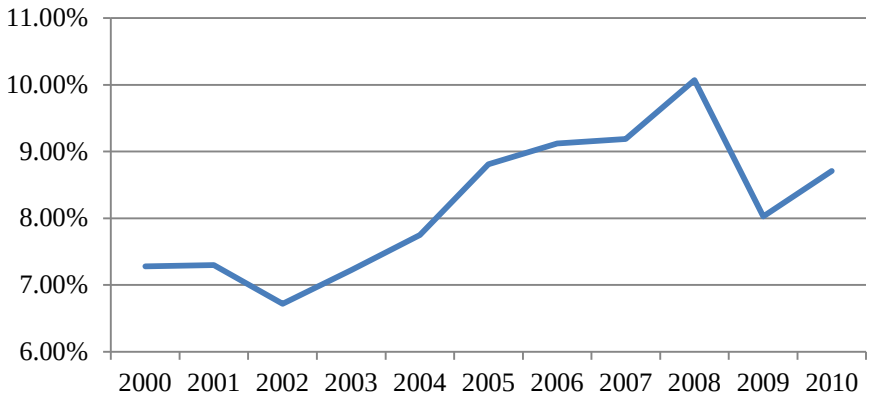
Exhibit 1-12. Energy expenditures per billion BTU trends in Pennsylvania (2010 dollars)



	Average annual growth rate
Energy expenditures per billion BTU	5.9%

Source: Energy Information Administration

Exhibit 1-13. Total energy expenses per real state gross domestic product, Pennsylvania (2010 dollars)



	Average annual growth rate
Total energy expenses per real state gross domestic product	1.8%

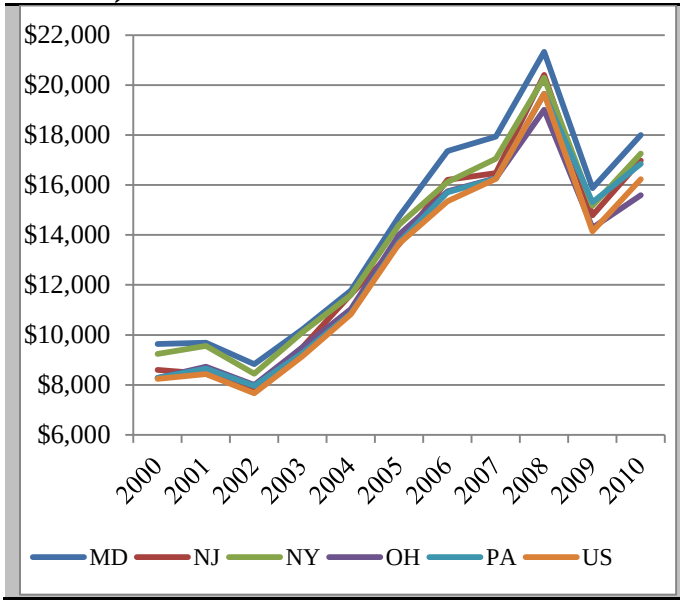
Source: Energy Information Administration

Pennsylvania's experience with increasing energy costs is also entirely consistent with that of nearby states. Trends for expenditures per billion BTU for Pennsylvania, nearby states, and the U.S. are tightly bunched throughout the 2000-2010 period. Maryland consistently spent slightly more than Pennsylvania and other states, but the trends among all these states are quite similar as indicated by Exhibit 1-14. One variable that is extremely difficult to consider is the impact of weather on energy utilization by state.

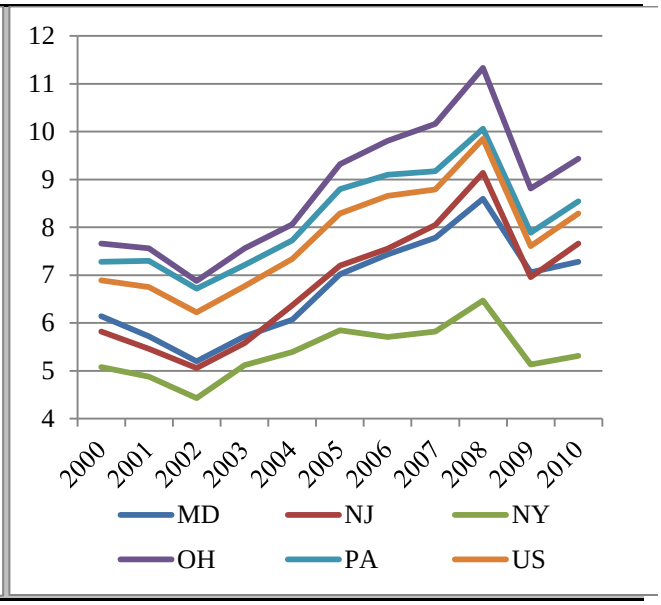
Energy expenditures in each state reflect their individual economic and energy-related characteristics. Ohio and Pennsylvania have historically been associated with a substantial manufacturing base, particularly energy-intensive manufacturing. New York's economy is dominated by New York City, a center for financial services, media and communications, and entertainment. In other words, New York is far more service oriented.

Exhibit 1-14. Total energy expenditure trends

Energy expenditures per billion BTU trends: Pennsylvania, nearby states and US (current dollars)



Total energy expenditures as percent of current-dollar GDP: Pennsylvania, nearby states and US



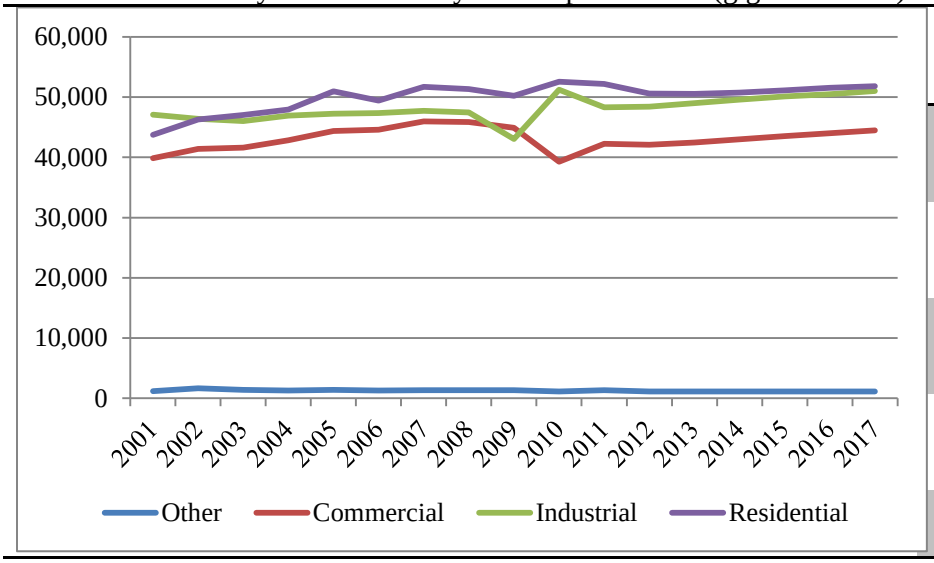
Source: Energy Information Administration

1.4 Electricity Consumption

Overall consumption of electricity in Pennsylvania is expected to grow at very modest rates from 2001 to 2017. The major consuming sectors will all grow at rates no greater than 0.7 percent. Overall growth is expected to average 0.6 percent per year as indicated by Exhibit 1-15. At least part of this is attributable to consumer desires to reduce energy expenditures, including through the purchase of increasingly energy efficient appliances.

The flat trend lines in sector-specific electricity consumption over time are consistent with the larger national picture. Residential and commercial rates of growth have steadily declined for decades with efficiency gains in appliances and equipment offsetting much of the growing demand arising from population growth and long-term increases in disposable income. Manufacturing shifts towards goods requiring less-energy intensive production tends to dampen that sector's demands.

Exhibit 1-15. Pennsylvania electricity consumption trends (gigawatt hours)



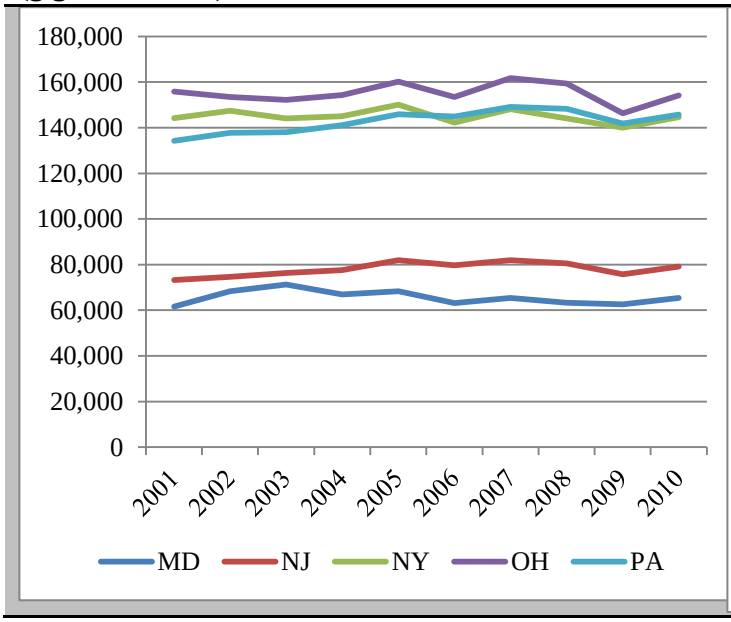
Average annual growth rate	
Other	-0.2%
Commercial	0.7%
Industrial	0.5%
Residential	1.1%
Total	0.6%

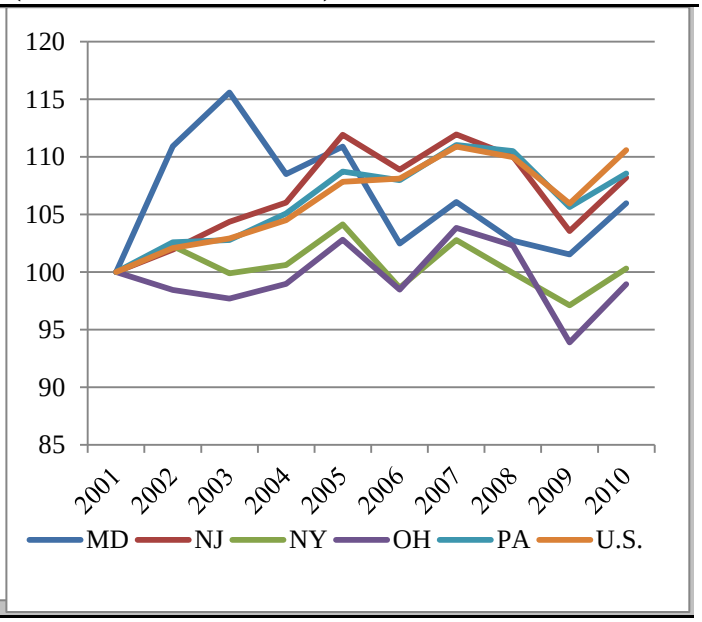
Source: Pennsylvania Public Utility Commission, Electric Power Outlook for Pennsylvania

The total volume of electricity consumed in Pennsylvania is similar to total consumption in Ohio and New York. Levels of consumption in New Jersey and Maryland are substantially lower as shown in Exhibit 1-16.

Exhibit 1-16. Total electricity consumption trends: Pennsylvania, nearby states and US

(gigawatt hours) **(indexed with 2001 = 100)**





Sources: Energy Information Administration, Pennsylvania Public Utility Commission, Electric Power Outlook for Pennsylvania

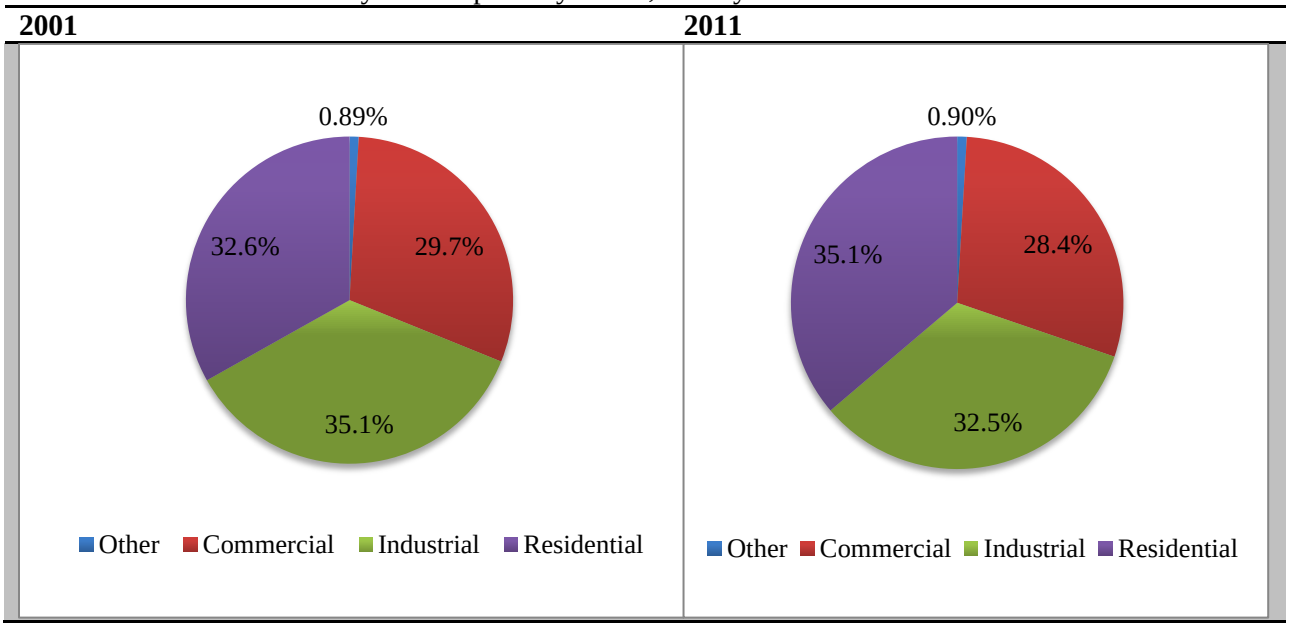
When total historic electricity consumption is indexed to the base year of 2000, Pennsylvania's growth in consumption over the 2000-2010 period is second only to New Jersey among nearby states. Trends in Pennsylvania were similar to those of the U.S. Over the decade, growth in

Maryland, New York, and especially Ohio was relatively slower. Year-to -year changes among these states over this period are substantial, with Maryland, the least populous of these states, exhibiting the most extreme year-to-year variation.

The distribution of electricity consumption by sector (see Exhibit 1-17) exhibited some significant changes from 2001 to 2011. Over that period, the residential share increased from 33 percent to 35 percent. This growth in residential share was primarily reflected in shrinkage in the share of electricity consumed by the commercial sector, which reduced its share from 30 percent to 28 percent, and the industrial share which declined almost 3 percent. Explanations for declining commercial share are not immediately obvious, but may at least be partially explained by more energy efficient office buildings, shopping centers and hotels due to the spread of green building practices. The share consumed by industrial activity also declined, decreasing from 35 percent to 33 percent. Transportation's share remained flat, but accounted for insignificant shares of total consumption in both 2000 and 2011.

These shifts in the distribution of consumption also reflect the sectors' varying growth rates (shown in Exhibit 1-15 above). Residential growth exceeded the overall growth rate for Pennsylvania. Commercial registered the lowest growth rate (0.2 percent).

Exhibit 1-17. Total electricity consumption by sector, Pennsylvania

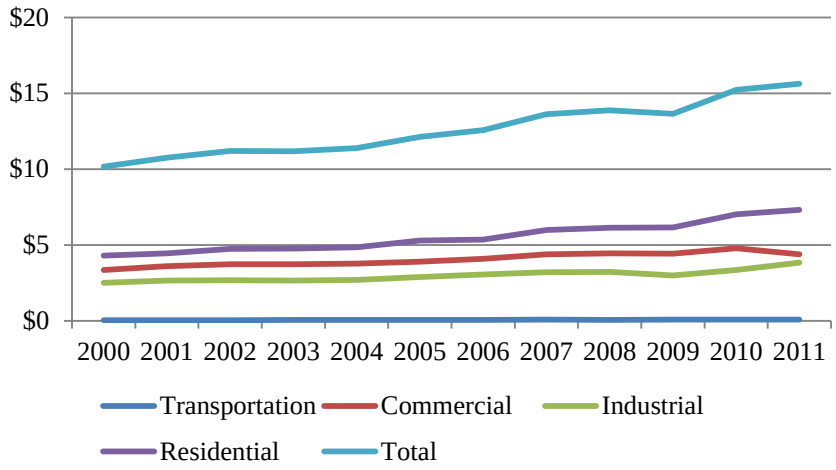


Source: Pennsylvania Public Utility Commission, Electric Power Outlook for Pennsylvania
Note: Percentages do not sum to 100% (the remainder is 'Sales for Resale')

Spending on electricity grew by an average of 4 percent per year in Pennsylvania from 2000 to 2010. Spending by the transportation segments expanded most rapidly (8.9 percent). Among the other sectors, residential grew fastest (5 percent per year); commercial spending grew slowest (2.5 percent per year), while growth in the industrial sector tracked the overall state average (4

percent per year). These varying rates of growth in each sector's electricity expenditures largely reflect the different growth rates in consumption by sector as well as the relative change in average electricity prices paid by each sector.

Exhibit 1-18. Electricity expenditures trends, Pennsylvania (billions of dollars)



	Average annual growth rate
Transportation	8.9%
Commercial	2.5%
Industrial	4.0%
Residential	5.0%
Total	4.0%

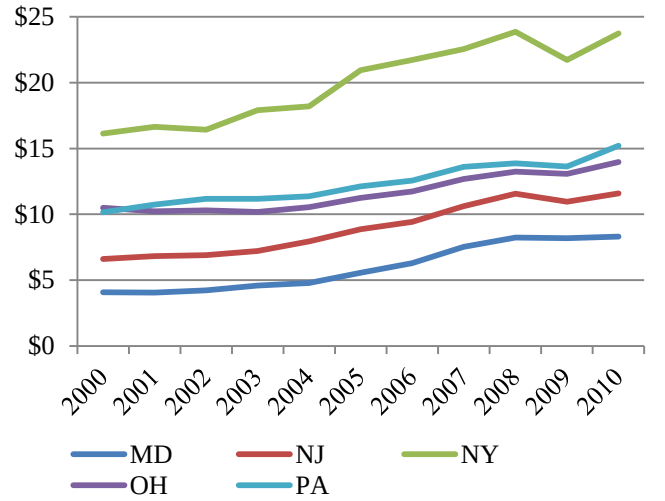
Source: Energy Information Administration

Total electricity spending in Pennsylvania was in the middle of the range among comparison states. New York's total spending was substantially higher than that of Pennsylvania's. Ohio and Pennsylvania tracked closely together, while New Jersey and Maryland consistently spent less on electricity.

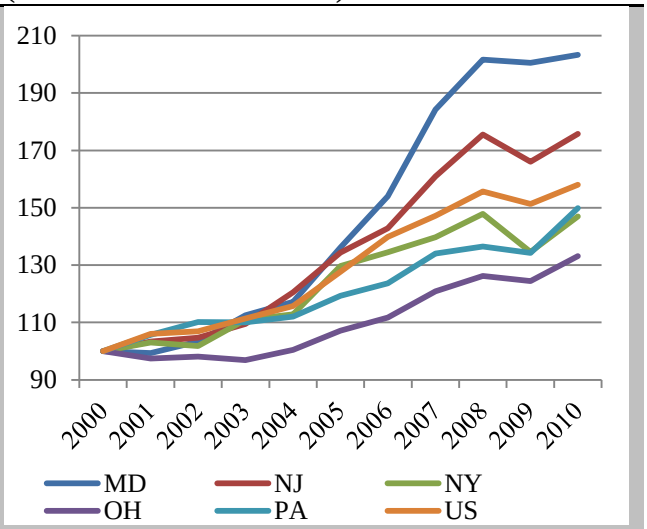
When total electricity spending is indexed to the base year of 2000, Pennsylvania's performance (an increase of 50 percent) is generally better than all nearby states except for Ohio, which saw spending rise about 30 percent. By 2010 spending in New York had experienced an increase similar to that of Pennsylvania's. Increases in the U.S., New Jersey, and Maryland were all higher than the increase in Pennsylvania. One factor in electricity expenditure trends is the potential dampening effect on prices of consumers' opportunity to choose their electric suppliers. See Exhibit 1-19.

Exhibit 1-19. Total electricity expenditure trends: Pennsylvania, nearby states and US

(billions of dollars)



(indexed with 2000 = 100)

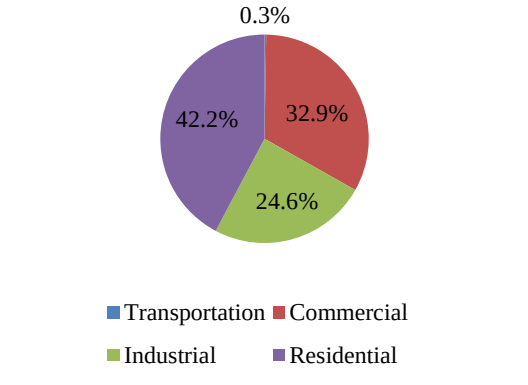


Source: Energy Information Administration

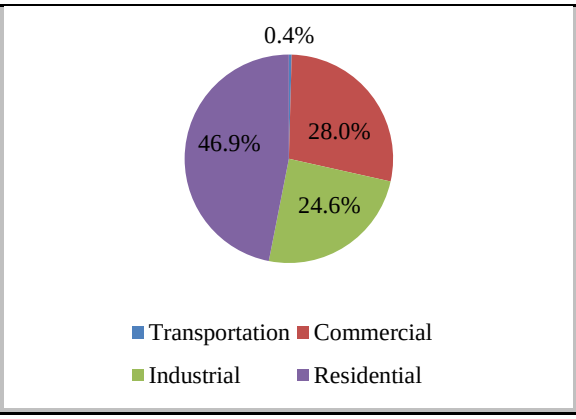
The distribution of spending on electricity in Pennsylvania is shown in Exhibit 1-20 for the years 2000 and 2011. Over that period, the share of total spending by the residential sector increased from 42.2 percent to 46.9 percent, a reflection in part of a significant increase in the housing stock in Pennsylvania between 2000 and 2010. This shift in residential expenditures was accommodated almost entirely by the commercial sector, which saw its share of total electricity spending shrink from 32.9 percent to 28 percent. Industrial activities consistently accounted for 24.6 percent of total spending on electricity. The transportation sector is responsible for the remaining sliver of spending on electricity. Details are shown in Exhibit 1-20.

Exhibit 1-20. Electricity expenditures distribution by sector, Pennsylvania (billions of BTU)

2000



2011



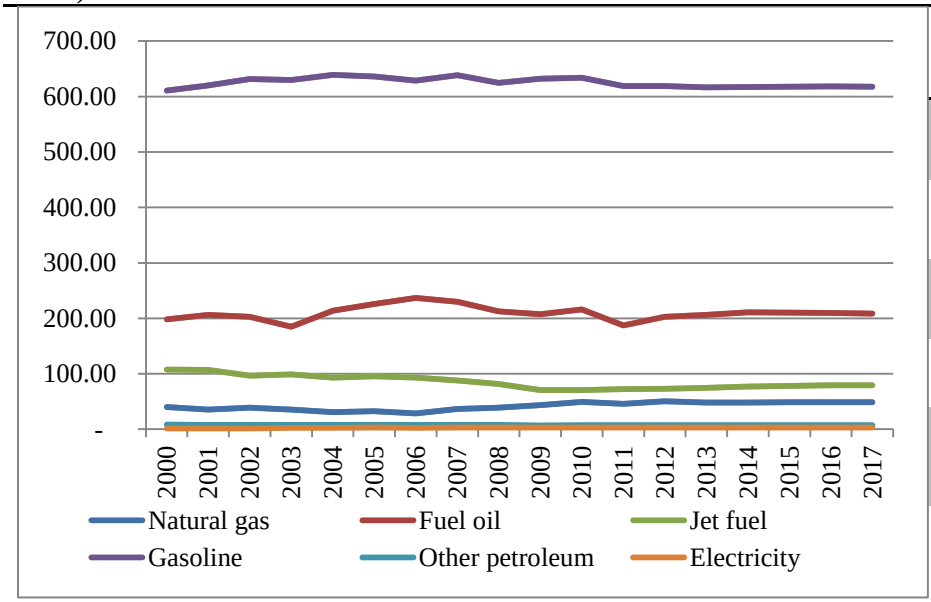
Source: Energy Information Administration

1.5 Energy Consumption by Sector

Transportation

From 2000 to 2017, Pennsylvania's total consumption of energy by transportation is expected to decrease at a rate of 0.3 percent per year (see Exhibit 1-3). Gasoline is the predominant fuel in this sector and its consumption is projected to be virtually unchanged over this period. The steepest decline is expected to be in the consumption of jet fuel (-1.8 percent/year) while natural gas consumption is expected to have the highest average growth rate (1.2 percent). Policy is an important factor in trends in transportation energy consumption as vehicle fuel economy improvements scheduled for the period up to 2025 as mandated by the federal CAFÉ standards tend to override increases in vehicle miles traveled. The fastest growing transportation fuel is expected to be electricity, in part due to the increase in electric-only vehicles. Electricity, however, is a minute portion of the overall fuel mix for transportation, amounting to roughly 0.3 percent of all transportation energy values in 2017. See Exhibit 1-21.

Exhibit 1-21. Pennsylvania transportation sector consumption by fuel type (trillions of BTUs) (2000 – 2017)



	Average annual growth rate
Natural gas	1.2%
Fuel oil	0.3%
Jet fuel	-1.8%
Gasoline	0.1%
Other petroleum	-1.2%
Electricity	5.0%

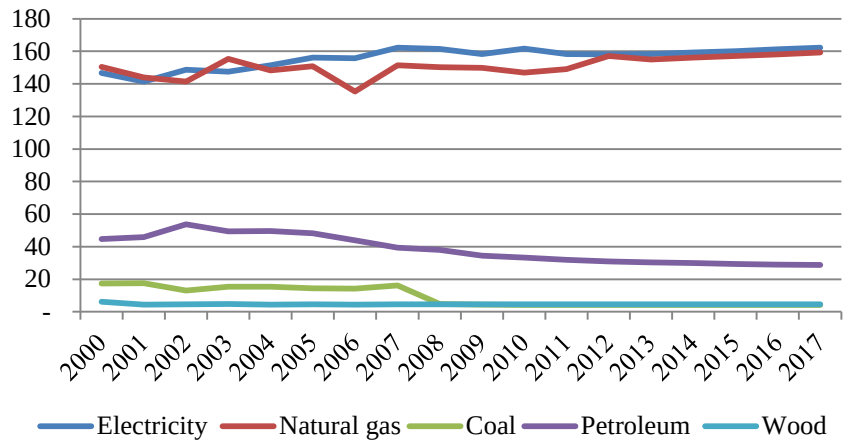
Source: Energy Information Administration

Commercial

Commercial consumption is dominated by electricity and natural gas, which are both expected to register relatively slight growth over the 2000-2017 period. All other fuel types in the commercial consumption sector are expected to have negative growth in this period as shown in Exhibit 1-22. Overall the sector is expected to reduce consumption at an average annual rate of 0.2 percent from 2000 to 2017 (see Exhibit 1-3) largely as a result of improved efficiencies in

equipment, lighting, and other facets of commercial operations. A conversion table is provided in Exhibit 1-23 to better reflect the volume of each fuel type in relation to BTUs.

Exhibit 1-22. Pennsylvania commercial sector consumption by fuel type (trillions of BTUs) (2000 – 2017)



	Average annual growth rate
Electricity	0.6%
Natural gas	0.3%
Coal	-8.1%
Petroleum	-2.5%
Wood	-1.6%

Source: Energy Information Administration

Exhibit 1-23. BTU conversion table

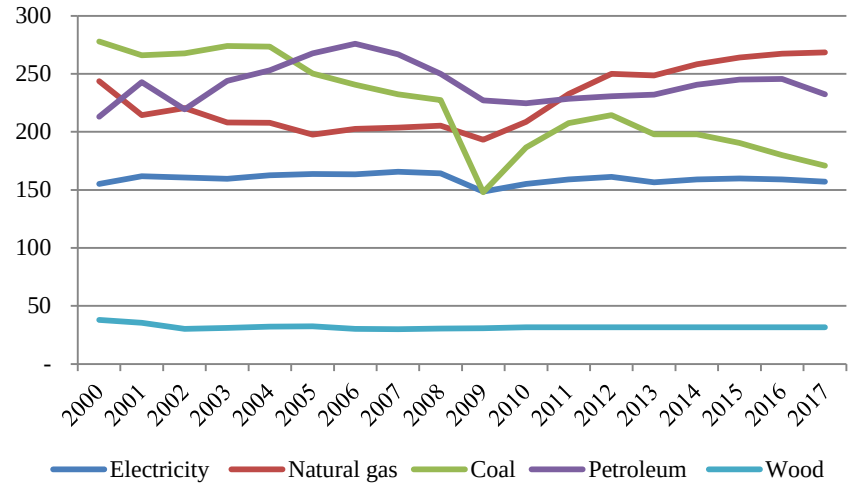
1 trillion BTU	=	189,000 barrels of petroleum
1 trillion BTU	=	978,473,581 cubic feet of natural gas
1 trillion BTU	=	51,065 short tons of coal
1 trillion BTU	=	293,083,236 kilowatt hours
1 trillion BTU	=	50,000 cords of wood

Source: Energy Information Administration, Annual Energy Review, Appendix A1-A5. Available at: http://www.eia.gov/totalenergy/data/annual/index.cfm#
http://www.eia.gov/tools/glossary/index.cfm?id=W (wood conversion)

Industrial

Industrial energy consumption shows some variability from 2000 to 2017. Coal, the dominant fuel type in 2000, shows the greatest reduction in consumption (-2.8 percent per year) while natural gas and petroleum are expected to experience positive growth with natural gas showing significant growth starting in 2009 with the advent of Marcellus Shale production and a consequent sharp drop in natural gas prices. Electricity consumption is virtually unchanged and consumption of wood declines on average over the period. See Exhibit 1-24.

Exhibit 1-24. Pennsylvania industrial sector consumption by fuel type (trillions of BTUs) (2000 – 2017)

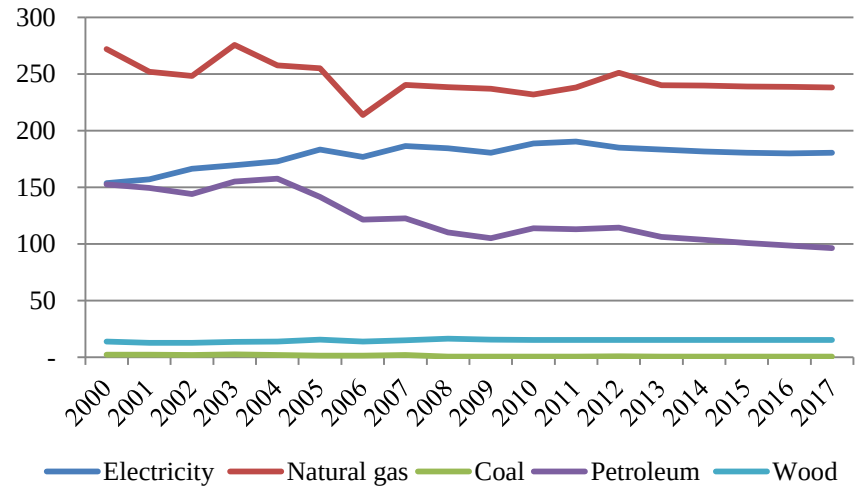


	Average annual growth rate
Electricity	0.1%
Natural gas	0.6%
Coal	-2.8%
Petroleum	0.5%
Wood	-1.1%

Source: Energy Information Administration

Natural gas, the most commonly consumed fuel in the residential sector, is expected to experience a modest decline in use from 2000 to 2017. Part of the decline in natural gas consumption is attributed to projections of gradually increasing temperatures with their impact on demands for heating, a primary use of natural gas in the residential sector. More importantly, a combination of more efficient appliances and household equipment working in conjunction with shrinking unit sizes will likely be associated with diminished residential natural gas consumption. Electricity use is expected to have a modest growth over that period, due in part to greater presence of appliances and personal devices that use electricity. All other fuel types are projected to have negative growth, particularly the use of coal as shown in Exhibit 1-25.

Exhibit 1-25. Pennsylvania residential sector consumption by fuel type (trillions of BTUs) (2000 – 2017)



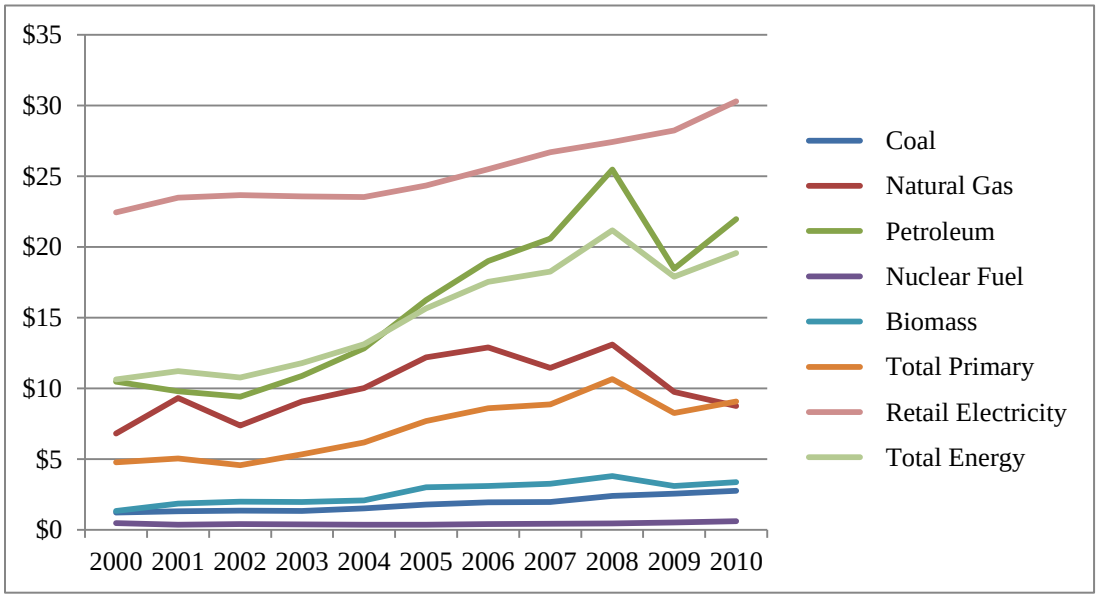
	Average annual growth rate
Electricity	1.0%
Natural gas	-0.8%
Coal	-8.0%
Petroleum	-2.7%
Wood	0.6%

Source: Energy Information Administration

1.6 Energy Prices

Energy consumption and expenditures are a function in part of energy prices. Exhibit 1-25 displays trends in Pennsylvania energy prices from 2000 through 2010. To allow comparability across types of energy, prices are expressed in dollars per million BTU. Dollar values are not adjusted for inflation, rather they represent the price in that year's dollars for the each of the years shown. Prices also reflect the weighted average prices paid across all sectors (i.e. residential, commercial, industrial, and transportation). Most of the energy prices shown are for primary energy (i.e. coal, natural gas, petroleum, nuclear fuel, and biomass). In addition, retail electricity and total energy prices are presented. Because of the energy losses invariably associated with the generation and transmission of electricity, retail electricity is the most expensive type of energy shown in Exhibit 1-26. The most volatile changes occurred in petroleum prices which have always been subject to global markets and are frequently subject to relatively sudden change.

Exhibit 1-26. Energy price trends in Pennsylvania (dollars per million BTU) (2000 – 2010)



Source: Energy Information Administration

Data through the end of 2012 show a rise in natural gas prices from December 2010 of 21 percent for residential customers and 3 percent for commercial customers. During the same time period for the electricity market, price changes resembled a much different pattern. Prices for residential customers only grew 3 percent and declined 4 percent and 6 percent for commercial and industrial customers respectively.[5]

[5] Energy Information Administration

Another perspective on Pennsylvania energy prices is presented in Exhibit 1-27 which provides the historic prices for 2000, 2005 and 2010 in current dollars (e.g., 2000 prices expressed in 2000 dollars). In relative terms, biomass, coal, and petroleum experienced the largest increases in prices, while nuclear fuel, natural gas, and retail electricity had the smallest increases. With one exception the pattern was for steadily increasing prices over this period. The exception was natural gas which price peaked in 2008 at $13.09; nearly double the price in 2000. Between 2008 and 2010, the price of natural gas dropped by about one-third to $8.75 as the rapidly increasing volume of production from Marcellus Shale transformed the natural gas market and drove prices down.

Exhibit 1-27. Energy prices in Pennsylvania: 2000, 2005, and 2010 (dollars per million BTU)

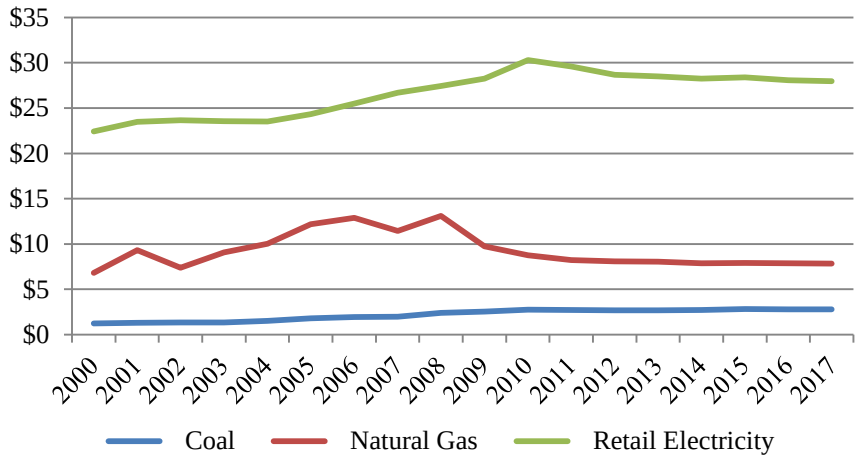
	2000	*2005*	*2010*	*Change 2000-10*	*Annual rate of change*
Coal	$1.23	$1.79	$2.75	124%	8.4%
Natural Gas	$6.81	$12.19	$8.75	28%	2.5%
Petroleum	$10.47	$16.24	$21.97	110%	7.7%
Nuclear Fuel	$0.48	$0.37	$0.61	27%	2.4%
Biomass	$1.34	$3.02	$3.37	151%	9.7%
Total Primary	$4.78	$7.70	$9.06	90%	6.6%
Retail Electricity	$22.43	$24.33	$30.29	35%	3.0%
Total Energy	$10.64	$15.66	$19.56	84%	6.3%

Source: Energy Information Administration

Exhibit 1-28 provides data on energy prices for coal, natural gas, and retail electricity. Prices are expressed in dollars per million BTUs. As a result, prices for these different fuels can be directly compared. Coal, the least expensive of these fuels, is projected to have the highest average annual growth rate in its price (5 percent). Natural gas and retail electricity are expected to increase at much more modest rates, 0.8 percent and 1.3 percent, respectively. This is at least partially explained by the potential impact on natural gas production and on the cost of producing electricity of Marcellus, Utica, and other unconventional shale formations.

These growth rates apply to the entire 2000 to 2017 period. As the exhibit indicates, these prices are expected to have peaked between 2008 and 2010. After these peaks, prices are expected to level off or, in the case of natural gas, decline sharply and then level off. Indeed, most of the growth in prices occurs before the presumed peak period of 2008 to 2010.

Exhibit 1-28. Selected energy prices in Pennsylvania: 2000 to 2017 (dollars per million BTUs) (2000 – 2017)

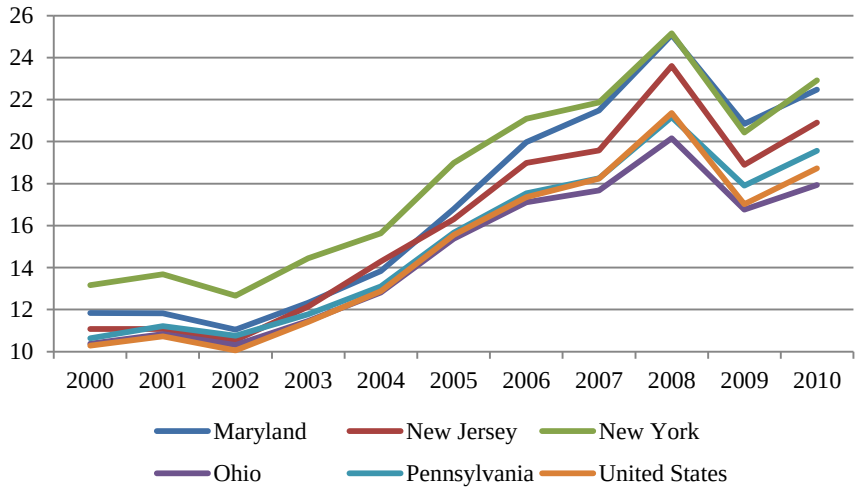


	Average annual growth rate
Coal	5.0%
Natural Gas	0.8%
Retail Electricity	1.3%

Source: Energy Information Administration

The total price for energy (i.e. the weighted average price for all fuels consumed by all users) in Pennsylvania compares favorably with most nearby states. Total energy prices tend to be somewhat higher in New York, Maryland, and New Jersey. Ohio's total energy price is slightly lower than Pennsylvania's, which typically tracks the national average. Growth rates for energy prices for all these states and the U.S. have been similar from a low of 5.6 percent in Ohio to 6.6 percent in Maryland and New Jersey. See Exhibit 1-29.

Exhibit 1-29. Total energy price in Pennsylvania, nearby states, and the U.S. (dollars per million BTUs) (2000 – 2010)



	Average annual growth rate
Maryland	6.6%
New Jersey	6.6%
New York	5.7%
Ohio	5.6%
Pennsylvania	6.3%
United States	6.2%

Source: Energy Information Administration

2.0 Energy Production

Pennsylvania has not only a remarkably broad array of primary energy resources--coal, crude oil, and natural gas, but also substantial production capacity and potential in each category. The relatively recent exploration and production of Marcellus, Utica, and other unconventional shale formations, made possible by advances in technology, is only the most recent example of the Commonwealth being in the forefront of energy production.

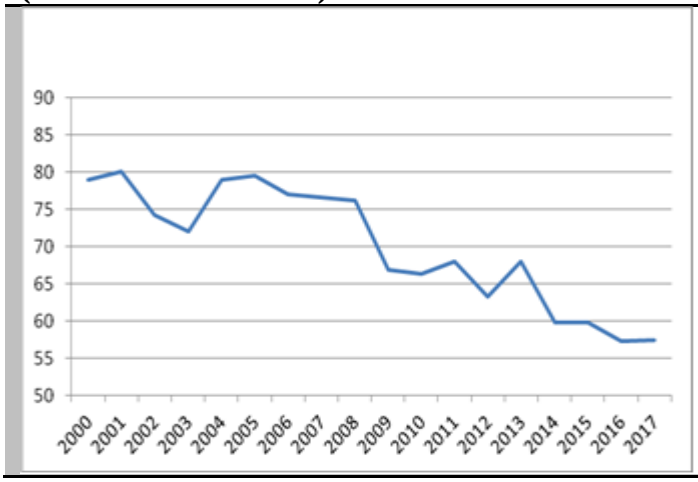
This Chapter encompasses the production of primary energy. Various types of renewable and alternative energy that are involved in the production of electricity are addressed in Chapter 3.

2.1 Coal

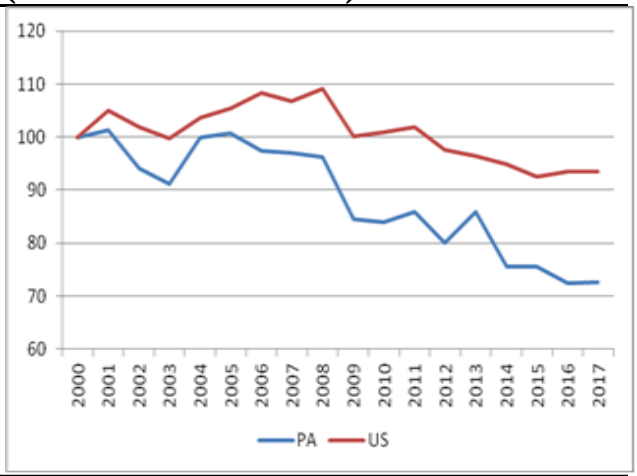
Coal production, which has been in decline since 2000, is expected to continue that decline until at least 2017 and probably beyond. While there are expected to be some year-to-year variations, production is expected to fall by more than one-quarter from 2000 to 2017. This rate of decline is different from the national experience with coal production. From 2000 to 2008, national coal production tended to increase before beginning a steady period of generally decreasing production. By 2017, national production is expected to be 6 percent below 2000 levels. By 2017, Pennsylvania production, on the other hand, is projected to be 73 percent of production levels in 2000 as shown in Exhibit 2-1.

Exhibit 2-1. Total coal production (2000 – 2017)

Production in Pennsylvania (millions of short tons)



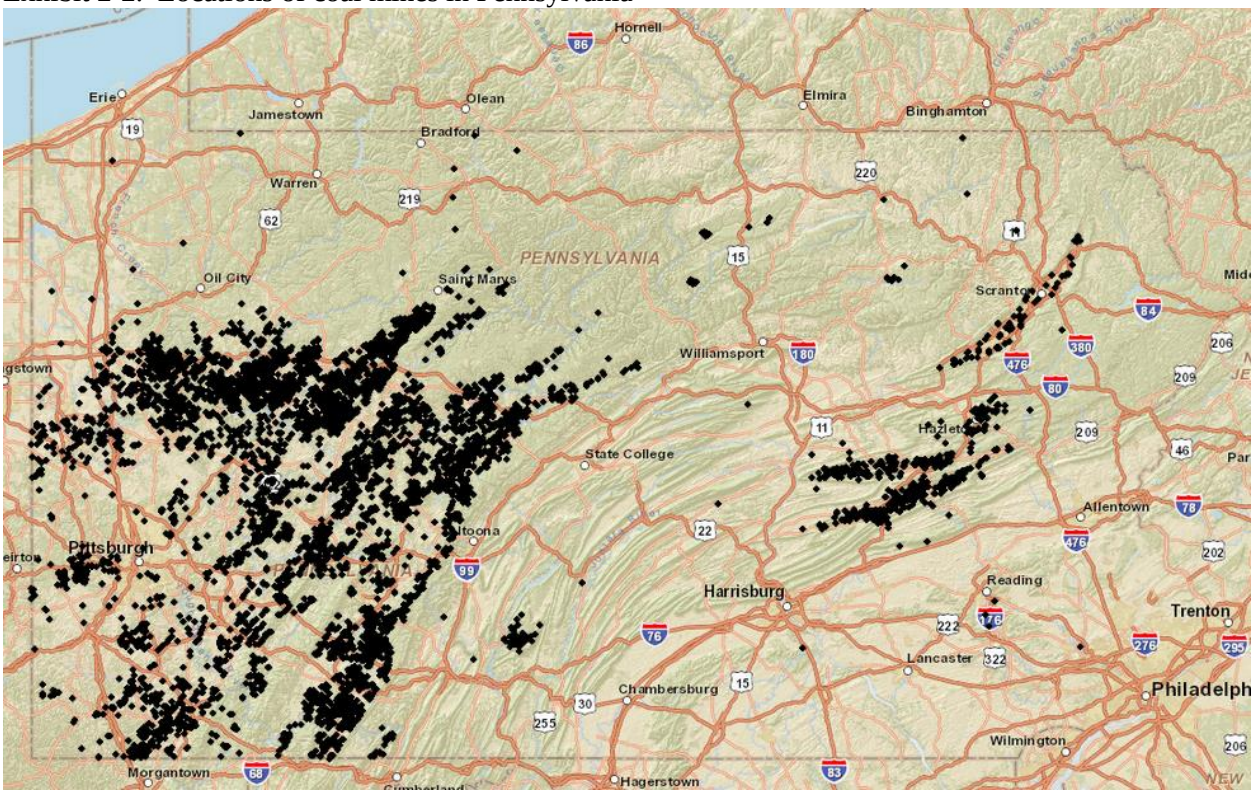
Production: Pennsylvania versus US (indexed with 2000 = 100)



Sources: U.S. figures-Energy Information Administration;
Pennsylvania figures- Pennsylvania Department of Environmental Protection, 2011 Annual Historical Report.

The majority of coal mines are located in the southwestern half of the state, which is where the main bituminous field is located.[6] A significant cluster, however, is located in eastern Pennsylvania north of Reading. Exhibit 2-2 provides general locational information on surface and underground coal mines. There are an estimated 400 coal mines in Pennsylvania. Exhibit 2-3 provides a summary of mines by type by county.

Exhibit 2-2. Locations of coal mines in Pennsylvania



Source: Pennsylvania Spatial Data Access
Penn State Institutes of Energy and the Environment

Supporting its position as the hub of the coal industry, southwestern Pennsylvania is home to two of the largest coal research facilities in the country – the National Energy Technology Center and Consol's Energy Research and Development Center, both located in Pittsburgh. Together, they account for nearly $500 million in coal-related research and development annually.[7]

[6] Ellis, George. Pennsylvania Coal Alliance, 2013.
[7] Ibid.

Exhibit 2-3. Pennsylvania coal mines by county, 2011

Anthracite	Underground Mines	Surface Mines	Coal Refuse Sites	Total
County				
Carbon	-	1	4	5
Columbia	1	3	1	5
Dauphin	1	-		1
Lackawanna	-	1	1	2
Luzerne	-	12	11	23
Northumberland	3	2	4	9
Schuylkill	6	39	25	70
*Region Total**	*11*	*58*	46	115

Bituminous	Underground Mines	Surface Mines	Coal Refuse Sites	Total
County				
Allegheny	0	4	0	4
Armstrong	6	18	0	24
Beaver	1	5	0	6
Bedford	0	2	0	2
Blair	0	2	0	2
Butler	0	6	0	6
Cambria	2	8	8	18
Cameron	0	2	0	2
Centre	0	8	1	9
Clarion	0	7	0	7
Clearfield	3	105	0	108
Elk	1	10	0	11
Fayette	0	12	3	15
Greene	6	3	0	9
Indiana	11	16	2	29
Jefferson	1	18	0	19
Lycoming	0	2	0	2
Mercer	0	2	0	2
Somerset	8	46	2	56
Tioga	0	1	0	1
Venango	0	2	0	2
Washington	1	5	1	7
Westmoreland	0	7	0	7
*Region Total**	*40*	*291*	17	348

*Because some companies operate in more than one county, this figure does not equal the sum of the individual county totals.

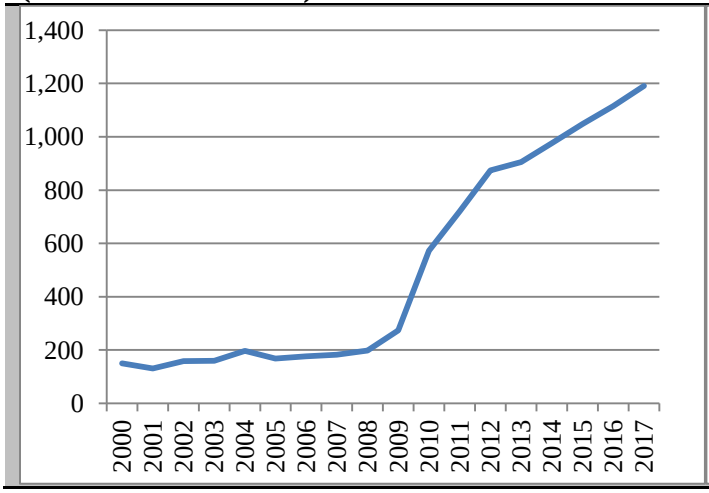
Source: Pennsylvania Department of Environmental Protection, Bureau of Mining Programs http://www.portal.state.pa.us/portal/server.pt/community/reports/20866

2.2 Natural Gas

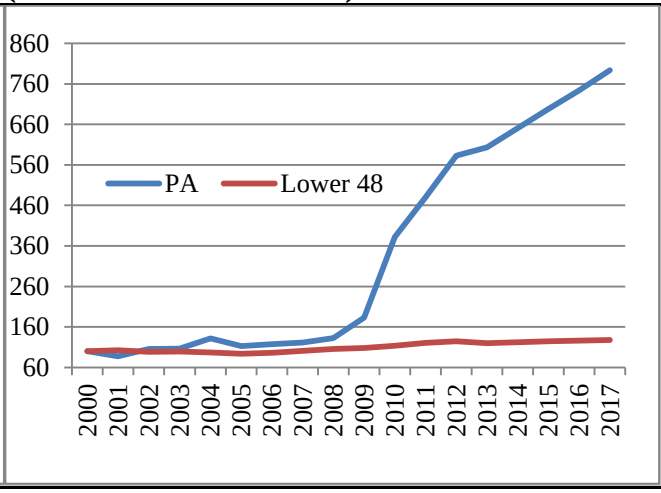
From 2000 to 2008, natural gas production barely expanded. Advances in horizontal drilling made the access of previously untapped shale gas resources such as the Marcellus Shale possible. Deploying this extraction technology to Pennsylvania had a dramatic impact on production levels with production almost tripling from 2008 to 2010. Year-to-year increases since 2008 have been substantial. The projections in Exhibit 2-4 are based on the latest U.S. Department of Energy's estimates for natural gas production in the Middle Atlantic region (New Jersey, New York, and Pennsylvania), a region where natural gas production is dominated by Pennsylvania. By 2017 Pennsylvania is expected to produce 1.2 trillion cubic feet of natural gas, almost eight times the volume produced in 2000. In the same period, national production is only expected to increase 27 percent.

Exhibit 2-4. Total natural gas production (2000 – 2017)

Production in Pennsylvania (billions of cubic feet)



Production: Pennsylvania versus US (indexed with 2000 = 100)



Source: Energy Information Administration

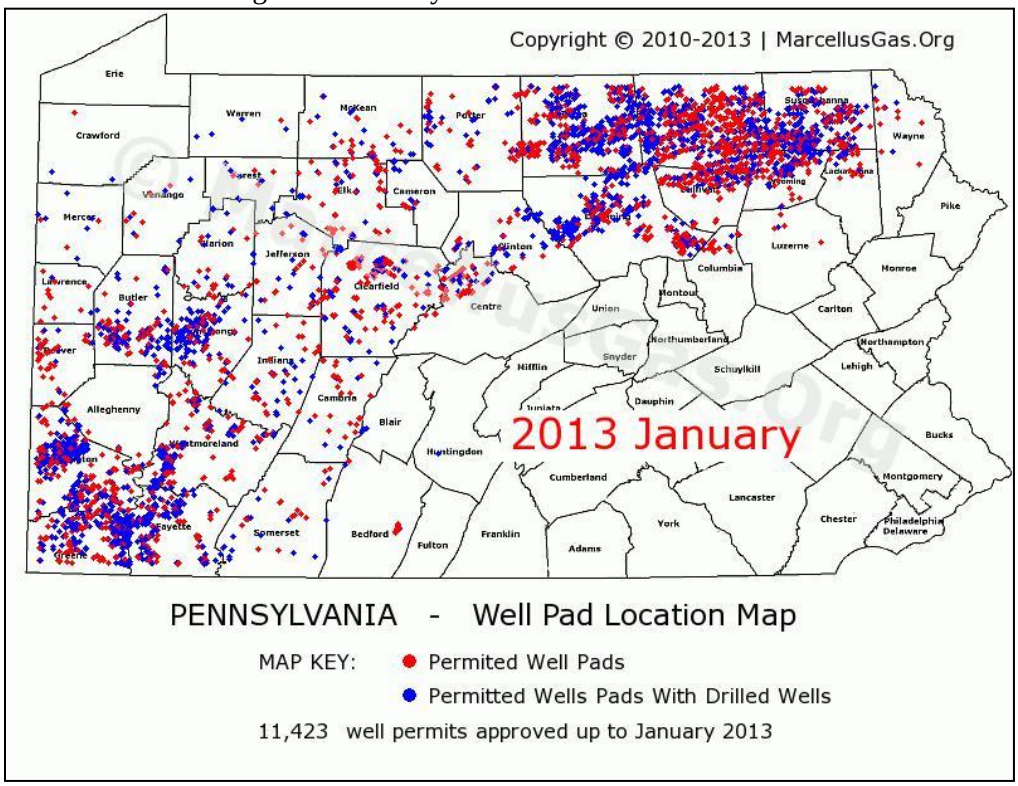
Marcellus Shale has transformed natural gas production in Pennsylvania. The projections presented above should be considered subject to a significant degree of uncertainty. For the last six months of 2011, production from the Marcellus Shale more than doubled over the same period in 2010, increasing from 271 million cubic feet to 631 million cubic feet. The same increase happened from the first six months in 2011 to the same period in 2012, with production climbing from 435 million cubic feet to 894 million cubic feet.[8]

According to the Pennsylvania Department of Environmental Protection, over 9,500 active and permitted Marcellus Shale gas wells existed in 2012. As shown in Exhibit 2-5, these wells were

[8] Marcellus Shale Coalition. (2012). "Marcellus Shale: By the Numbers: as of 10/15/12." Available at http://marcelluscoalition.org/wp-content/uploads/2012/10/Shale-Facts_10_2012.pdf.

located across a wide swath of Pennsylvania covering the northern and western regions of the state. The greatest concentrations of activity as measured by number of wells were in the northeastern area of the state, centered around Bradford County and in the southwestern corner of the state. Note that these areas of activity are also areas where horizontal wells are located.

Exhibit 2-5. Natural gas well activity



Source: MarcellusGas.org

Exhibit 2-6 summarizes the number of active and producing natural gas and oil wells in the state by county. Each category of well is mutually exclusive. For example, Allegheny County is reported to have had four active and producing Marcellus Shale wells in the second half of 2011, 612 non-Marcellus Shale wells only producing gas, an additional 52 non-Marcellus Shale wells only producing oil, and 83 non-Marcellus Shale wells producing both oil and gas.

Exhibit 2-6. Active and producing natural gas and oil wells in Pennsylvania, 2011

County	*Marcellus wells*	*Non-Marcellus wells (all of 2011)*		
	(Jul-Dec 2011)	Gas only	Oil only	Oil & gas
Allegheny	4	612	52	83
Armstrong	80	6,514	19	161
Beaver	-	0	22	9
Bradford	368	9	7	0
Butler	58	255	35	12
Cambria	1	378	0	53
Cameron	5	20	0	0
Centre	24	688	0	0
Clarion	8	2,229	11	318
Clearfield	39	3,418	0	370
Clinton	31	381	0	0
Crawford	-	2,143	21	434
Elk	12	1,000	19	1,008
Erie	-	760	0	7
Fayette	111	2,670	0	42
Forest	1	344	440	2,584
Greene	283	1,094	34	163
Huntingdon	1	2	0	0
Indiana	19	9,231	0	598
Jefferson	7	4,827	0	50
Lawrence	-	157	0	0
Lycoming	162	-	-	-
McKean	25	827	651	5,597
Mercer	-	2,361	3	306
Potter	38	454	56	153
Somerset	5	45	0	2
Susquehanna	220	-	-	-
Tioga	254	4	0	0
Venango	1	1,302	860	200
Warren	2	1,514	1,039	5,217
Washington	353	719	92	45
Westmoreland	129	4,244	4	254
Wyoming	16	-	-	-
Total	*2,257*	*48,202*	*3,365*	*17,666*

Source: Pennsylvania Department of Environmental Protection, Oil & Gas Reporting
https://www.paoilandgasreporting.state.pa.us/publicreports/Modules/Welcome/Agreement.aspx

Given the variability in well counts across counties, it follows that production volumes also vary considerably by county. Exhibit 2-7 summarizes the volume of natural gas and oil that is produced in those counties with active wells.

Exhibit 2-7. Pennsylvania Oil & Gas Production by County, 2011

County	Marcellus		Non-Marcellus		Total	
	Gas (Mcf)	Oil (Bbl)	Gas (Mcf)	Oil (Bbl)	Gas (Mcf)	Oil (Bbl)
Allegheny	2,480,604	0	3,477,985	37,218	5,958,589	37,218
Armstrong	6,230,295	0	18,833,735	11,101	25,064,030	11,101
Beaver	-	-	544002.92	1,040	544002.92	1039.82
Bradford	287,676,292	0	784,209	497	288,460,501	497
Butler	10,267,619	299	340,863	5,596	10,608,482	5,895
Cambria	20,146	0	1,072,573	1	1,092,719	1
Cameron	309,713	0	73,103	0	382,816	0
Centre	5,165,727	0	1,549,915	0	6,715,642	0
Clarion	542,677	171	19,017,062	8,815	19,559,739	8,986
Clearfield	15,084,786	0	8,581,111	87	23,665,897	87
Clinton	13,646,072	0	1,100,638	0	14,746,710	0
Crawford	-	-	12,166,761	131,278	12,166,761	131277.55
Elk	2,050,299	0	3,627,685	225,280	5,677,984	225,280
Erie	-	-	1061871.84	1841.84	1061871.84	1841.84
Fayette	25,585,199	0	9,727,005	3,816	35,312,203	3,816
Forest	138,658	0	4,478,717	377,613	4,617,375	377,613
Greene	118,919,305	0	23,352,200	23,352	142,271,505	23,352
Huntingdon	70,200	0	231,175	0	301,375	0
Indiana	2,658,839	0	33,173,906	4,340	35,832,745	4,340
Jefferson	475,763	0	11,725,905	879	12,201,669	879
Lawrence	-	-	352,065	0	352,065	0
Lycoming	80,831,926	0	-	-	80,831,926	0
McKean	5,475,264	0	6,303,602	836,268	11,778,866	836,268
Mercer	-	-	7,597,979	18,923	7,597,979	18,923
Potter	9,235,784	0	766,071	2,092	10,001,855	2,092
Somerset	364,486	0	309,759	0	674,245	0
Susquehanna	201,472,607	0	-	-	201,472,607	0
Tioga	125,724,369	0	619,231	0	126,343,600	0
Venango	33,709	0	4,643,030	71,439	4,676,739	71,439
Warren	30,804	0	4,417,583	423,373	4,448,387	423,373
Washington	67,577,920	384,398	52,179,547	47,433	119,757,468	431,831
Westmoreland	21,768,192	0	17,214,690	38,218	38,982,882	38,218
Wyoming	14,467,473	0	-	-	14,467,473	0
Total	*1,018,304,727*	*384,868*	*249,323,980*	*2,270,500*	*1,267,628,707*	*2,655,368*

Source: Pennsylvania Department of Environmental Protection, Oil & Gas Reporting
https://www.paoilandgasreporting.state.pa.us/publicreports/Modules/Welcome/Agreement.aspx

The development of unconventional natural gas resources like Marcellus Shale in part prompted Pennsylvania to enact stricter environmental controls. These standards were codified in Act 13, which was the state's first major update of natural gas extraction environmental protection standards to the 1984 Oil and Gas Act.[9] Specifically, it increased setback requirements for

[9] http://www.portal.state.pa.us/portal/server.pt/community/act_13/20789

unconventional gas development, enhanced the protection of water supplies, and created more consistent environmental standards to be adhered to by local governments. Act 13 also authorized Pennsylvania's Department of Environmental Protection to create a Natural Gas Energy Development Program, which makes $20 million in grant funds available on a competitive basis to purchase or convert eligible vehicles to natural gas. As of 2010, natural gas only comprised 5 percent of total energy consumption in transportation (see Exhibit 1-2). Finally, Act 13 established an Unconventional Gas Well Fee, an Oil and Gas Lease Fund, and updated resource protection guidelines.

2.3 Crude Oil

While natural gas production in Pennsylvania has dominated business headlines in recent years, crude oil production has also experienced substantial growth since 2000. From a level of approximately 1.5 million barrels in 2000, Pennsylvania-based production expanded to 4 million barrels in 2005 before dropping to a level of about 3.5 million barrels, perhaps a response to far lower prices for this commodity after mid-2008. By 2017 production is expected to approach 4 million barrels again due to a combination of a larger global economy and expected price dynamics. The enormous projected increase in drilling activities associated with Marcellus, Utica, and other unconventional shale formations is also a factor in increasing crude oil production. County-level oil production is provided in Exhibit 2-7.

While oil prices are notoriously volatile, worldwide demand may well continue to sustain the historically high prices for oil that have encouraged production in recent years. The technology that makes Marcellus, Utica, and other unconventional shale formations viable for natural gas production is also a boon to oil production. Finally the increased exploration and production activities associated with natural gas may have spillover effects for oil production, as Pennsylvania becomes a hub for personnel, equipment, and technology.

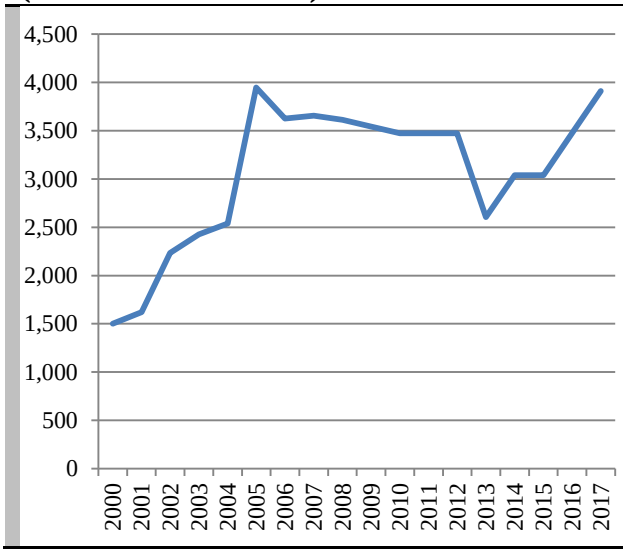
Pennsylvania's year-to-year variability in production is much greater than the nation's. In comparison to Pennsylvania, national production is expected to be relatively stable from 2000 to 2017, having decreased by 15 percent from 2000 to 2008 before turning around and steadily increasing. By 2017, national production is projected to be 11 percent higher than the level achieved in 2000. That year, Pennsylvania's production is expected to be more than two and one-half times the volume that was produced in 2000. See Exhibit 2-8.

Pennsylvania ranked 19th among 31 states that produced crude oil in September 2012. Texas, North Dakota, California, and Alaska, the top four states, produced 50 to 200 times the estimated volume produced in Pennsylvania in that month. Given this small base of production, relatively small absolute changes in production can have a relatively large impact on overall production

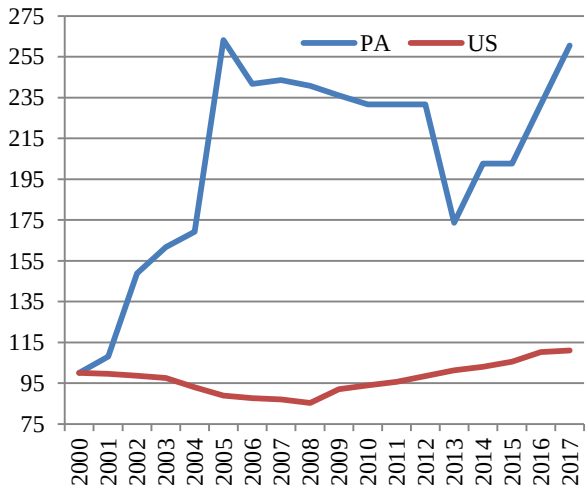
trends.[10] Given the co-production of natural gas and crude oil from some wells in the state (see Exhibit 2-7), the continued exploration and production of shale gas deposits may also, as noted above, increase future crude oil production volumes.

Exhibit 2-8. Total crude oil production (2000 – 2017)

Production in Pennsylvania (thousands of barrels)



Production: Pennsylvania versus US (indexed with 2000 = 100)



Source: Energy Information Administration

2.4 Biodiesel

Data regarding biodiesel production are available from 2008. Since that year, production has increased from an initial annual production of 25 million gallons to more than 40 million gallons in 2011. Production in the first six months of 2012 was over 20 million gallons, a pace well above that of 2011.

These production levels represent only a minority of the capacity for biodiesel in the state. From 2008 through 2011, production represented only 30 percent to 40 percent of total capacity. For the first half of 2012, however, more than 50 percent of total capacity was utilized.

This increased capacity utilization is due in part to decreases in total statewide capacity. Capacity in 2008 exceeded 85 million gallons. New producers entered the market in following

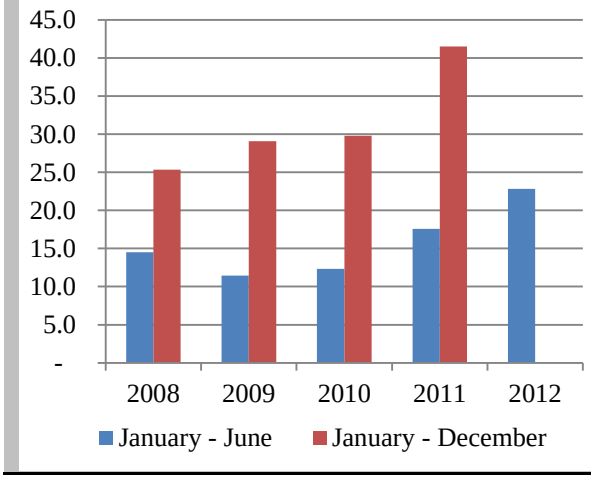
[10] U.S. Department of Energy and Energy Information Administration. (September 2012). "Pennsylvania: Rankings: Crude Oil Production (thousand barrels)." Available at http://www.eia.gov/beta/state/rankings/?sid=PA#series/46.

years, increasing capacity to a peak of over 106 million gallons in 2011. Reported capacity in 2012 dropped to 82 million gallons as several producers exited the market.[11]

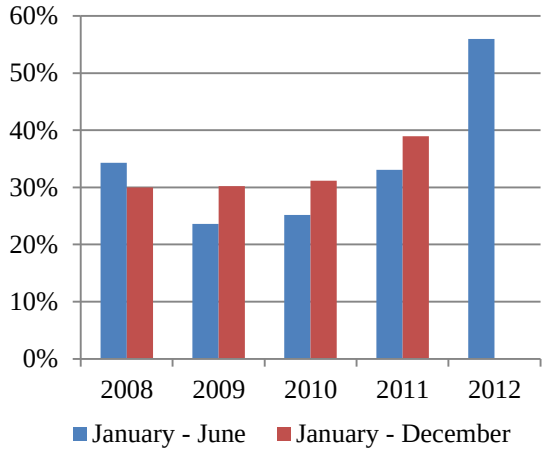
Exhibit 2-9 presents production data on Pennsylvania's biodiesel industry. Production data and share of capacity data are provided for the first six months of each year from 2008 to 2012 and for full years from 2008 to 2011.

Exhibit 2-9. Total biodiesel production (2008 – 2012)

Production in Pennsylvania (millions of gallons)



Share of capacity used



Source: Pennsylvania Department of Agriculture

Pennsylvania-based production has been rising with time and there is little reason to believe that this will not continue. This expectation is driven in part by public policy. For instance, Pennsylvania law provides incentives for biodiesel production. Once statewide production reaches 40 million gallons as it did in 2011, all diesel fuel sold in Pennsylvania must contain at least 2 percent biodiesel (B2) in the following year. This requirement for blending biodiesel increases as statewide production increases as indicated below.[12]

- 5 percent biodiesel (B5) one year after in-state production of biodiesel reaches 100 million gallons;
- 10 percent biodiesel (B10) one year after in-state production of biodiesel reaches 200 million gallons; and
- 20 percent biodiesel (B20) one year after in-state production of biodiesel reaches 400 million gallons.

[11] Pennsylvania Department of Environmental Protection. (n.d.) "In-state biodiesel production through June 2012."
[12] Alternative Fuels Data Center. (n.d.). "Pennsylvania Laws and Incentives for Biodiesel." U.S. Department of Energy. Available at http://www.afdc.energy.gov/laws/laws/PA/tech/3251.

A list of biodiesel facilities are provided in Exhibit 2-10 below. Production data are reflected in gallons.

Exhibit 2-10. Biodiesel facilities and production in Pennsylvania, 2008-2012

	Production (gallons)				
Facility	2008	2009	2010	2011	2012 Jan-Jun
American Biodiesel Energy	-	53,387	154,008	176,055	0
Eagle Biodiesel, Inc.	4,500	1,144.00	906,003.00	1,316,103.00	119,700.00
Keystone Biofuels, Inc.	2,494,705.50	2,817,871	2,813,978	3,028,335	3,062,470
Lake Erie Biofuels	20,974,512	23,812,053	23,706,345	36,341,775	19,555,123
Middletown Biofuels	373,815	973,701	395,173	-	-
Mother Earth Energy, Inc.	-	104,485.00	741,440.00	345,709.00	-
Pennsylvania Biodiesel	596,319	809,477	696,742	45,606	-
Soy Energy	169,150.00	111,896	91,253	0	-
United Biofuels, Inc.	561,850	19,300	310,182	-	-
United Oil Company Corp.	164,700	375,599.00	-	267,003.00	84,845
Total	25,339,552	29,078,913	29,815,124	41,520,586	22,822,138.00

Source: Pennsylvania Department of Agriculture

2.5 Ethanol

Ethanol has a relatively recent history in Pennsylvania. The state's only large-scale production facility, built in 2009 in Clearfield County, has annual capacity of 110 million gallons of ethanol derived from 40 million bushels of grain. Initial production began in early 2010, but was stopped in June 2011. In June 2012, production was restarted after a change in ownership.[13] It is not clear whether production will reach its prior level or if new entrants will appear in the local marketplace. The 2012 drought and its impact on corn production has produced diminished enthusiasm as has the cessation of $6 billion in annual support of corn farmers from the federal government.[14] The lifting of the tariff on sugarcane-based ethanol also suggests that this energy segment may experience relative soft growth during the years ahead.

[13] Evans, Aaron T. (June 1, 2012). "Event Officially Marks Return of Ethanol Production in Clearfield." Gantdaily.com. Available at http://gantdaily.com/2012/06/01/event-officially-marks-return-of-ethanol-plant-in-clearfield/.

[14] As of January 1, 2012, a $0.46 per gallon federal tax credit expired. Whether this will lead to lower ethanol production may depend on the oil prices which affect the attractiveness of ethanol as an additive and federal regulations that require that gasoline include some renewable fuels. See Miguel Llanos, “”$^ billion-a-year ethanol subsidy dies—but wait there’s more,” NBC News, December 29, 2011. usnews.nbcnews.com/_news/2011/12/29/

2.6 Landfill Gas/Methane

Landfill gas represents another alternative source of energy production that has been used primarily for the generation of electricity, but has also been used for other purposes such as direct thermal and for the conversion of liquefaction into transportation fuels. The most recent survey in 2010 indicated 42 active projects, four planned projects, and the potential for another 17 projects occurring at the various 28 landfill sites. If all planned and potential projects were realized, the state could have a total of 74 projects by 2017. A complete listing of active, planned, and potential projects is provided at the end of Appendix 2.

Using landfill gas as a fuel is beneficial to the environment since it prevents the release of methane and carbon dioxide into the atmosphere. In the past, it was simply collected and flared, but now many landfills are taking advantage of their waste gas, using it to produce heat and power. Landfill gas is similar to natural gas, but with a smaller percentage of methane and half the BTU content resulting in fewer emissions.[15]

The annual generating capacity of the 42 active plants in Pennsylvania exceeds 37 billion cubic feet. If all currently planned projects were developed, this generating capacity would increase to over 40 billion cubic feet per year by 2015. An additional 28 projects with a total capacity of over 17 billion cubic feet per year are described as "potential projects." These potential projects would not come online until approximately 2017.[16]

Methane has become an economically viable source of power generation in Pennsylvania making it one of the state's more significant opportunity fuels. Methane gas, typically released from coal mines, can be collected before, during, and after mining, and condensed into a fuel resembling the properties and heat content of natural gas.[17] Approximately 75 percent of the methane produced by active projects in the state is used for power generation. These active projects resulted in the generation of almost 900 million kilowatt hours of electricity. This amounts to roughly one-third of one percent of the total electricity generated in Pennsylvania in 2011.

2.7 Other Types of Energy and Renewable Energy

This section focuses on primary energy production and those forms of renewable energy that are not used exclusively or almost exclusively for electricity generation. Other forms of renewable energy that are primarily used for electricity generation, including wind, solar, biomass,

[15] U.S. Department of Energy, Energy Efficiency and Renewable Energy. "Combined Heat and Power Market Potential for Opportunity Fuels." August 2004.
[16] Pennsylvania Department of Environmental Protection. "2010 Landfill methane summary statistics."
[17] U.S. Department of Energy, Energy Efficiency and Renewable Energy. "Combined Heat and Power Market Potential for Opportunity Fuels." August 2004.

hydroelectricity, municipal solid waste (or waste-to-energy), and wood, are discussed in Chapter 3 of this report which focuses on electricity.

2.8 Economic Characteristics of Energy Production

In order to provide stakeholders with a sense of the absolute and relative economic importance of different Pennsylvania fuel types, economic profiles and forecasts are provided for coal and natural gas. These economic impact statements measure the contribution of production of these fuels on statewide employment, payrolls and business sales.

Coal

The production of primary energy is an economic driver for Pennsylvania. Exhibit 2-12 presents historic data collected by the U.S. Bureau of the Census regarding jobs, annual payroll, and business establishments in the coal mining industry (NAICS[18] code 2121). As shown in Exhibit 2-12, job growth showed year-to-year variation from 2000 to 2010. Nevertheless, employment was up about 5 percent during that decade. Over the same period, payrolls increased steadily while the number of mining establishments dropped 20 percent.

These data represent estimates of direct employment and payroll in the coal mining industry. Not included are the multiplier effects of these jobs (i.e. the supply chain for the coal mining industry or the induced economic impacts supported by the wages of coal miners and their supply chain). The Pennsylvania Economy League of Southwestern Pennsylvania released a study in 2010 that did estimate these effects. The report showed that the coal mining industry supported approximately 32,853 full- and part-time indirect and induced jobs in Pennsylvania in 2008.[19] Southwestern Pennsylvania has a strong concentration of manufacturers producing machinery equipment. These manufacturers represent a portion of the indirect jobs the industry produces. Statewide, Pennsylvania has the largest mining and equipment manufacturing industry in the country, accounting for 27 percent of that sector's national employment.[20]

A more recent study conducted by the National Mining Association estimates the economic contribution of the U.S. mining industry. The report shows Pennsylvania ranks third among all states with respect to direct and indirect employment attributable to mining. A detailed breakdown of impacts in Pennsylvania is provided in Exhibit 2-11 below.

[18] The North American Industry Classification System (NAICS) is the standard used by Federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy.
[19] Pennsylvania Economy League of Southwestern Pennsylvania, LLC. (April 2010). *The Economic Impact of the Coal Industry in Pennsylvania.* Prepared for Families Organized to Represent the Coal Economy, Inc.
[20] Ellis, George. Pennsylvania Coal Alliance, 2013.

Exhibit 2-11. Coal Mining Employment in Pennsylvania, 2010

Direct Job Category	**Direct Job Number**
Mine Workers	13,090
Support Activities	500
Transportation	7,110
Total Direct	20,700
Indirect and Induced	42,290
Total	**62,990**

Source: The National Mining Association, "The Economic Contributions of U.S. Mining in 2010," http://www.nma.org/pdf/economic_contributions.pdf.

Some of these impacts of coal mining are addressed in other sections of this report, which address energy-intensive industries in Pennsylvania. To avoid any potential double-counting of jobs and other economic effects, economic characteristics are confined to the direct employment in coal mining and other industries addressed in this document.

In this and other sections, data on the economic characteristics of the energy industry are restricted to historic (i.e. actual) employment and other factors. Projecting future employment and other economic characteristics is difficult because the volume of energy production has a complicated relationship to employment and business formation. Technology and productivity, among other variables, can often reduce the need for jobs despite increasing production volumes. For example, natural gas production levels tripled between 2008 and 2010 while employment in natural gas and oil extraction increased by roughly one-third (see Exhibit 2-14 below). Between 2000 and 2010 coal production dropped about 20 percent, but employment in coal mining increased modestly, while the number of coal mining business establishments decreased by over 20 percent.

Exhibit 2-12. Coal mining economic characteristics

	Jobs	*Annual payroll (millions)*	*Business establishments*
2000	8,668	$380	254
2001	8,528	$392	243
2002	7,790	$376	224
2003	6,345	$368	208
2004	7,210	$443	207
2005	7,234	$455	203
2006	6,983	$456	201
2007	7,226	$481	199
2008	7,696	$553	209
2009	7,324	$563	207
2010	7,254	$571	200
2011	8,103	N.A.	N.A.

Sources: Jobs: Pennsylvania Department of Environmental Protection, Annual Historical Reports
Annual payroll & Business establishments: US Census Bureau, County Business Patterns
**2003 jobs figures do not include employees at anthracite coal refuse sites (not reported)

More granular locational perspective regarding coal mining business activity is presented in Exhibit 2-13, which lists the number of coal mining establishments in the state by county. Employment data at the county level are routinely subject to restrictions on disclosure. Establishment data are more generally available and indicate where in Pennsylvania coal mining business establishments are concentrated.

Exhibit 2-13. Coal mining operators and employees by county, 2011

Anthracite	Operators				Employees			
	Underground Mines	Surface Mines	Coal Refuse	Total	Underground Mines	Surface Mines	Coal Refuse	Total
County								
Carbon		1	2	3		17	18	35
Columbia	1	3	1	5	34	51	2	87
Dauphin	1			1	3			3
Lackawanna		1	1	2		4	1	5
Luzerne		9	8	17		245	49	294
Northumberland	3	2	4	9	14	6	39	59
Schuylkill	6	31	19	56	43	221	165	429
*Region Total**	11	42	34	87	94	544	274	912

Bituminous	Operators				Employees			
	Underground Mines	Surface Mines	Coal Refuse	Total	Underground Mines	Surface Mines	Coal Refuse	Total
Allegheny	0	3	0	3	0	21	0	21
Armstrong	2	9	0	11	241	82	0	323
Beaver	1	3	0	4	19	19	0	38
Bedford	0	2	0	2	0	22	0	22
Blair	0	2	0	2	0	15	0	15
Butler	0	4	0	4	0	54	0	54
Cambria	2	7	6	15	125	46	41	212
Cameron	0	1	0	1	0	15	0	15
Centre	0	6	1	7	0	35	1	36
Clarion	0	4	0	4	0	90	0	90
Clearfield	1	38	0	39	176	507	0	683
Elk	1	3	0	4	17	49	0	66
Fayette	0	9	3	12	0	58	11	69
Greene	5	3	0	8	3,532	12	0	3,544
Indiana	3	12	2	17	458	64	9	531
Jefferson	1	12	0	13	41	75	0	116
Lycoming	0	1	0	1	0	39	0	39
Mercer	0	2	0	2	0	34	0	34
Somerset	4	14	2	20	598	522	5	1,125
Tioga	0	1	0	1	0	2	0	2
Venango	0	2	0	2	0	9	0	9
Washington	1	3	1	5	25	91	4	120
Westmoreland	0	5	0	5	0	27	0	27
*Region Total**	13	99	13*	121*	5,232	1,888	71	7,191

*Some companies operate in more than one county; figures do not equal the sum of individual county total.
Source: Pennsylvania Department of Environmental Protection, Bureau of Mining Programs.
http://www.portal.state.pa.us/portal/server.pt/community/reports/20866

Natural Gas and Crude Oil

Employment in natural gas and crude oil extraction (NAICS code 2111) nearly tripled from 2000 to 2010. Payrolls increased sharply over that period while the number of establishments also grew by more than one-third. Details are provided in Exhibit 2-14. Again these data are for direct jobs only in the natural gas and crude oil extraction industry.

Overall employment in natural gas and crude oil extraction and related industries totals more than 234,000 according to the Marcellus Shale Coalition. These jobs are attributed to Marcellus and related shale industries. The average wage of these workers is $83,065, more than double the state's average wage. The average wage of supply chain, or indirect jobs associated with shale drilling equals $64,799.[21] 7 in 10 new hires in the state currently occur in this industry.[22]

Exhibit 2-14. Natural gas and crude oil extraction economic characteristics (2000 – 2010)

	Jobs	*Annual payroll (millions)*	*Business establishments*
2000	1,242	$48	148
2001	1,567	$72	148
2002	1,754	$85	152
2003	3,566	$236	167
2004	3,667	$251	167
2005	1,809	$105	150
2006	2,093	$147	160
2007	2,695	$151	171
2008	2,457	$189	189
2009	2,987	$247	218
2010	3,270	$329	211

Source: US Census, County Business Patterns

[21] Marcellus Shale Coalition. *Marcellus Shale: By the Numbers.* 1/2/2013.
[22] Marcellus Shale Coalition Members Survey, 2012

Businesses continue to invest in Marcellus, Utica, and other unconventional shale formations. A survey of Marcellus Shale Coalition members in 2012 showed that total investment by exploration and production companies showed that total investment in Pennsylvania – including investments in leasing and bonuses, exploration, drilling and completion, pipelines and processing, and royalties – was $5.14 billion in 2010 and is expected to be $13.459 billion in 2013.[23] Key survey results are presented in Exhibit 2-15 below.

Pennsylvania's Marcellus Shale industry also contributes to the local and state economy. IHS Global Insight conducted an economic and fiscal impact study of the electric power industry's contribution to the Pennsylvania economy in 2010. This total represents estimates of direct, indirect, and induced activity. The study showed that the Marcellus Shale industry supported a total of over 100,000 jobs, approximately 26,000 direct jobs and over 77,000 indirect and induced jobs. From a fiscal standpoint, the Marcellus Shale industry paid almost $3 billion in local and state taxes. A detailed breakdown of impacts in Pennsylvania is provided in Exhibit 2-16 below. Exhibit 2-17 lists the number of natural gas and crude oil extraction business establishments by county in Pennsylvania.

Finally, the distribution of employment in the coal mining and natural gas and crude oil extraction industries can be approximated by reviewing county-level data collected by the Pennsylvania Department of Labor and Industry.[24] Because these data include employment in mining other than coal mining and in quarrying, they include more jobs than those in just coal mining and natural gas and crude oil extraction. Data are for the first quarter of 2009. As shown, roughly 40 percent (more than 8,000 jobs out of almost 21,000 total jobs) are in four counties--Greene, Indiana, Armstrong, and Washington. See Exhibit 2-18.

[23] Ibid.
[24] Pennsylvania Department of Labor and Industry. "Summary industry profile for Mining, Quarrying, and Oil and Gas Extraction in Pennsylvania." Available at http://paworkstats.geosolinc.com/vosnet/lmi/industry/industrysummary.aspx?session=inddetail&section=indempdata&geo=4201000000&naicscode=21.

Exhibit 2-15. Marcellus Shale Coalition Members Investment in Pennsylvania (millions of current dollars)

	2008 Actual	2009 Actual	2010 Actual	2011 Prelim.	2012 Planned	2013 Planned
Total Spending	**$3,224**	**$5,144**	**$11,171**	**$16,131**	**$15,802**	**$13,459**
Lease & Bonus	$1,837	$2,115	$2,755	$1,542	$1,166	$675
Exploration	$122	$114	$279	$525	$488	$252
Drilling & Completion	$858	$2,094	$6,321	$10,822	$9,344	$7,995
Pipeline & Processing	$329	$680	$1,347	$2,194	$3,048	$2,529
Royalties	$22	$52	$271	$586	$567	$810
Other	$56	$89	$198	$462	$1,189	$1,198

Source: Marcellus Shale Coalition Members Survey, 2012

Exhibit 2-16. Unconventional oil and gas activity, economic and fiscal impacts in Pennsylvania, 2012

Employment (1)	
Direct	25,628
Indirect	33,219
Induced	43,821
Total Employment	*102,668*

Estimated Tax Revenues (2) (billions of dollars)	
Federal Taxes	$1.7
State and Local Taxes	$1.3
Total	*$3.0*
Notes: (1) Full time equivalent (FTEs) employees (2) Direct, Indirect, and Induced Taxes	

Source: IHS Global Insight

Exhibit 2-17. Natural gas and crude oil extraction business establishments in Pennsylvania by county

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Allegheny	23	24	23	20	21	20	20	20	24	27	31
Armstrong	10	10	11	11	11	11	12	15	15	14	12
Bedford				1	1	1	1	1	1	1	
Berks											
Bucks											
Butler				4	4	4	4	5	4	4	4
Centre					1	1	1	2	2	3	1
Chester				1	1	1	1	1	1	1	1
Clarion	13	12	13	12	12	12	12	12	12	13	13
Clearfield				1	1	1	1	5	2	2	1
Clinton										0	1
Crawford				1	1	1	1	3	2	3	4
Dauphin											1
Delaware						1	1	1	1	2	2
Elk					1	1	1	1	1	1	1
Erie	4	3	3	3	3	4	4	4	4	5	4
Fayette				3	2	2	2	4	4	5	4
Forest				4	3	3	4	4	5	6	6
Greene				3	4	5	5	5	6	7	8
Indiana	19	21	21	23	22	22	26	27	33	33	33
Jefferson	6	6	6	6	6	7	7	6	7	7	7
Lackawanna							0	1		0	1
Lehigh				1	1	1	1	1	1	1	1
Luzerne						1	1	1	1	2	2
Lycoming									1	2	4
McKean	17	18		21	21	23	27	27	25	27	27
Mercer				3	2	2	2	2	2	3	3
Montgomery			5	5	5	4	3	3	3	3	3
Northampton											1
Northumberland											1
Philadelphia				1	1						
Pike											
Potter				1	1	1	1	1	2	1	
Somerset										1	1
Susquehanna								0	1	1	1
Tioga								1	1	1	2
Venango			5	6	7	8	7	6	8	6	6
Warren	15	14	13	15	14	18	20	20	20	20	21
Washington	5	3	5	5	4	6	8	8	9	11	15
Westmoreland				2	2	1	2	2	2	2	4
Wyoming									1	1	1
Unknown/Unidentified	8		4	3	3	3	5	11	16	23	23
PA-Statewide	158	152	151	154	153	164	180	199	218	236	248

Source: Bureau of Labor Statistics

Exhibit 2-18. Pennsylvania employment in mining, quarrying, and oil and gas extraction by county, 2009

1	Greene County	3,091
2	Indiana County	2,469
3	Armstrong County	1,453
4	Washington County	1,238
5	Somerset County	975
6	McKean County	928
7	Allegheny County	883
8	Jefferson County	759
9	Butler County	606
10	Clearfield County	577
11	Fayette County	569
12	Schuylkill County	480
13	Westmoreland County	400
14	Clarion County	375
15	York County	371
16	Lancaster County	370
17	Luzerne County	351
18	Mercer County	284
19	Unknown County	259
20	Crawford County	255
21	Susquehanna County	247
22	Northumberland County	205
23	Warren County	203
24	Cambria County	190
25	Bucks County	187
26	Beaver County	138
27	Statewide, Multiple Counties	130
28	Lycoming County	112
29	Wayne County	108
30	Venango County	105
31	Centre County	97
32	Forest County	83
33	Cumberland County	71
34	Lawrence County	66
35	Monroe County	47
36	Columbia County	46
37	Northampton County	43
38	Lackawanna County	39
39	Wyoming County	25
40	Potter County	10

Note. Employment in the following counties was not disclosed-- Lehigh, Berks, Blair, Montgomery, Chester, Fulton, Erie, Delaware, Adams, and Huntingdon.

Source: Pennsylvania Department of Labor and Industry

3.0 Electricity Generation

Pennsylvania ranks second in the U.S. in terms of electricity generation. It is also the number one exporter of electricity in the country.[25]

Electricity generation in Pennsylvania expanded at a modest 1.3 percent annual rate from 2000 to 2010. That growth rate is projected to shrink to 0.1 percent from 2010 to 2017. As a result, the average annual growth rate for the period from 2000 to 2017 is expected to be 0.8 percent. Efficiency gains in lighting, appliances, and equipment, particularly in the commercial and residential sectors, have helped to dampen demand for electricity and will continue to do so.

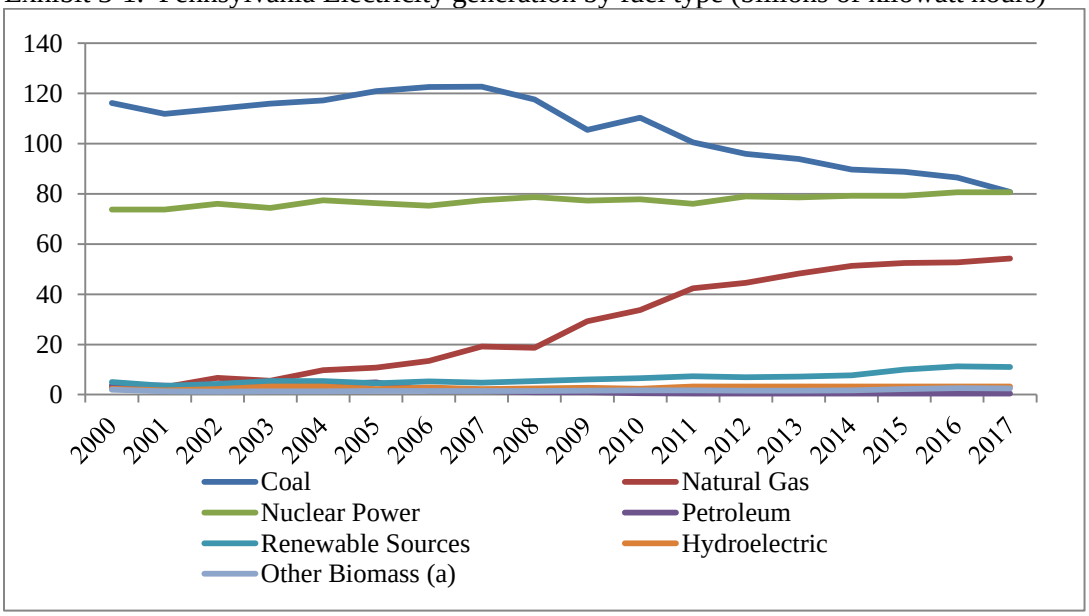
This modest growth is in contrast to certain categories within the context of that overall generation. The mix of fuels used to produce that electricity has shifted substantially in recent years and is expected to continue to change over the near-term.

3.1 Generation by Fuel Type

Coal has been the dominant type of fuel used to produce electricity in Pennsylvania for many years. By 2017 that could likely change as a constant and accelerating movement away from coal will lead to a virtual tie between coal and nuclear power as the most common fuel sources in Pennsylvania. Quickly converging on these fuels is natural gas. Exhibit 3-1 presents trends in electricity generation by fuel type.

[25] Electric Power Generation Association presentation by President Douglas L. Biden before the Consumer Affair Committee, Pennsylvania House of Representatives, February 10, 2011

Exhibit 3-1. Pennsylvania Electricity generation by fuel type (billions of kilowatt hours)



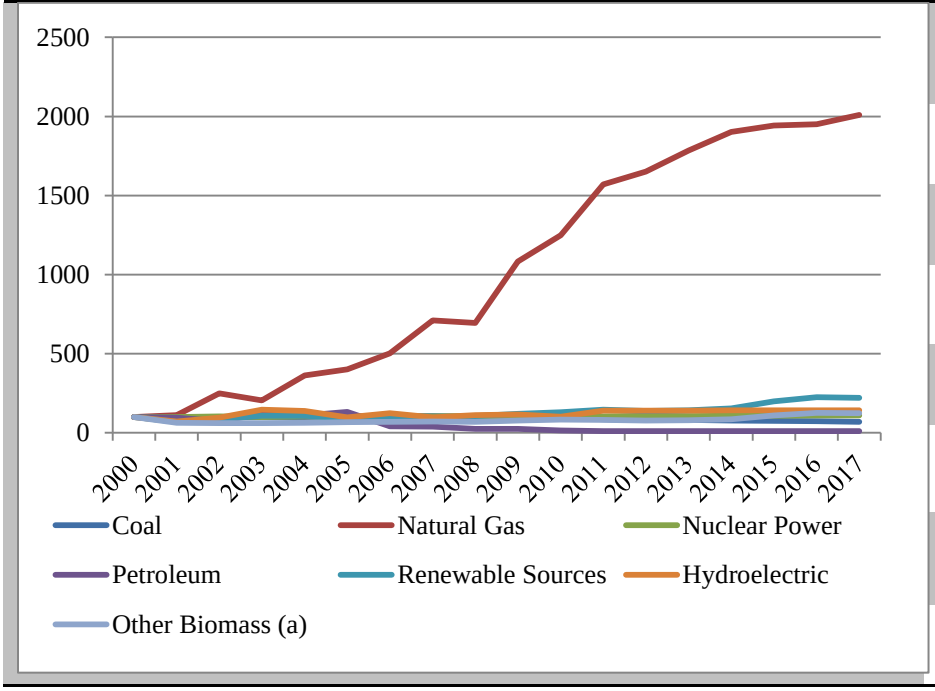
Source: Pennsylvania Public Utility Commission, Energy Information Administration

When electricity generation by fuel type is indexed (i.e. values for all fuels are set at 100 for the year 2000; all subsequent changes are measured relative to that 2000 value), the remarkable gain in the use of natural gas for electricity generation is rendered more apparent. For the 2000 to 2017 period, the average annual growth rate in the use of natural gas is expected to be 19.3 percent. In other words, in 2017, the volume of electricity generation from natural gas (more than 54 billion kilowatt hours) is projected to be more than twenty times the volume of electricity generated from natural gas in 2000 (2.7 billion kilowatt hours).

0This remarkable shift towards natural gas is attributable to a combination of factors, including the explosive growth in natural gas production, the consequent lowering of its price, and its relatively clean-burning qualities. Natural gas has tended to displace coal, which has relatively high environmental and emission costs. The second highest growth rate is projected to be for renewables (nearly 5 percent per year). Other positive growth rates are substantially lower for "other" biomass (1.2 percent), hydroelectric (2.1 percent), and nuclear (0.5 percent). Coal and especially petroleum have experienced and are projected to continue to experience negative growth, primarily as a function of natural gas' expanding presence. These trends and corresponding average annual growth rates are presented in Exhibit 3-2.

Exhibit 3-2. Pennsylvania electricity generation trends by fuel type

(indexed 2000 = 100)

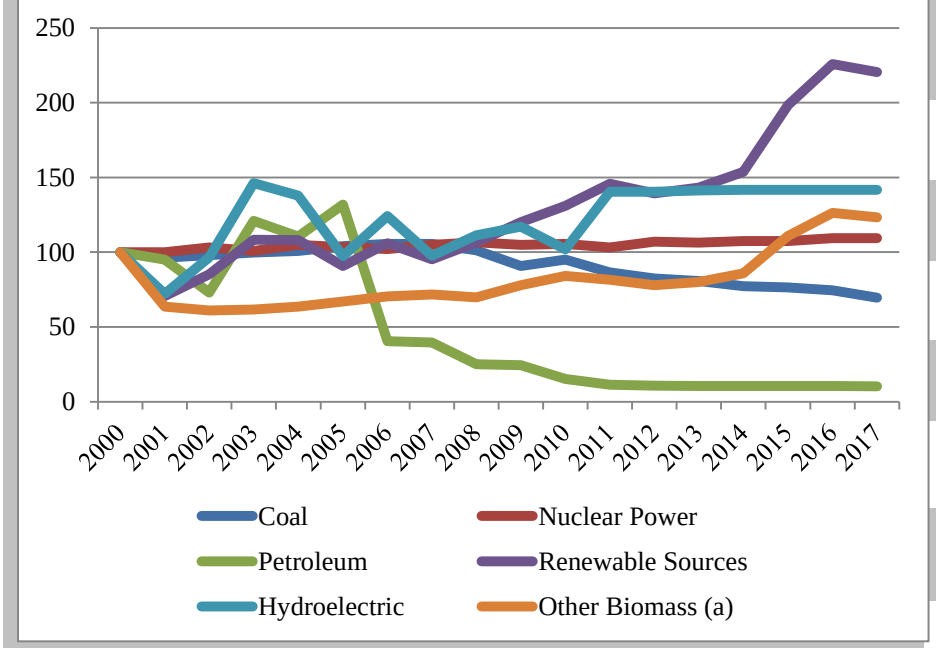


Average annual growth rate	
Coal	-2.1%
Hydroelectric	2.1%
Natural Gas	19.3%
Nuclear	0.5%
Other (Non-Woody) Biomass	1.2%
Petroleum	-12.6%
Renewable	4.8%

Source: Energy Information Administration

By excluding natural gas, trends in the use of other fuels for electricity generation in Pennsylvania can be seen more clearly. See Exhibit 3-3. Renewable fuel sources are clearly growing in relative terms, particularly from 2009 onwards. On the other hand, petroleum is expected to show the greatest relative declines with a major drop off from 2005 to 2006 and slowly declining trends thereafter. Petroleum-fired plants are frequently older, less efficient units that are retired and replaced as newer, more efficient, and cleaner units come online. The declining trend for coal is relatively steady. The second fastest growing fuel type after renewables is other (non-woody) biomass, essentially fuel derived from municipal solid waste. Hydroelectric shows modest growth while nuclear also grows but at a very modest rate.

Exhibit 3-3. Pennsylvania electricity generation trends by fuel type other than natural gas
(indexed 2000 = 100)



Average annual growth rate	
Coal	-2.1%
Hydroelectric	2.1%
Nuclear	0.5%
Other (Non-Woody) Biomass	1.2%
Petroleum	-12.6%
Renewable	4.8%

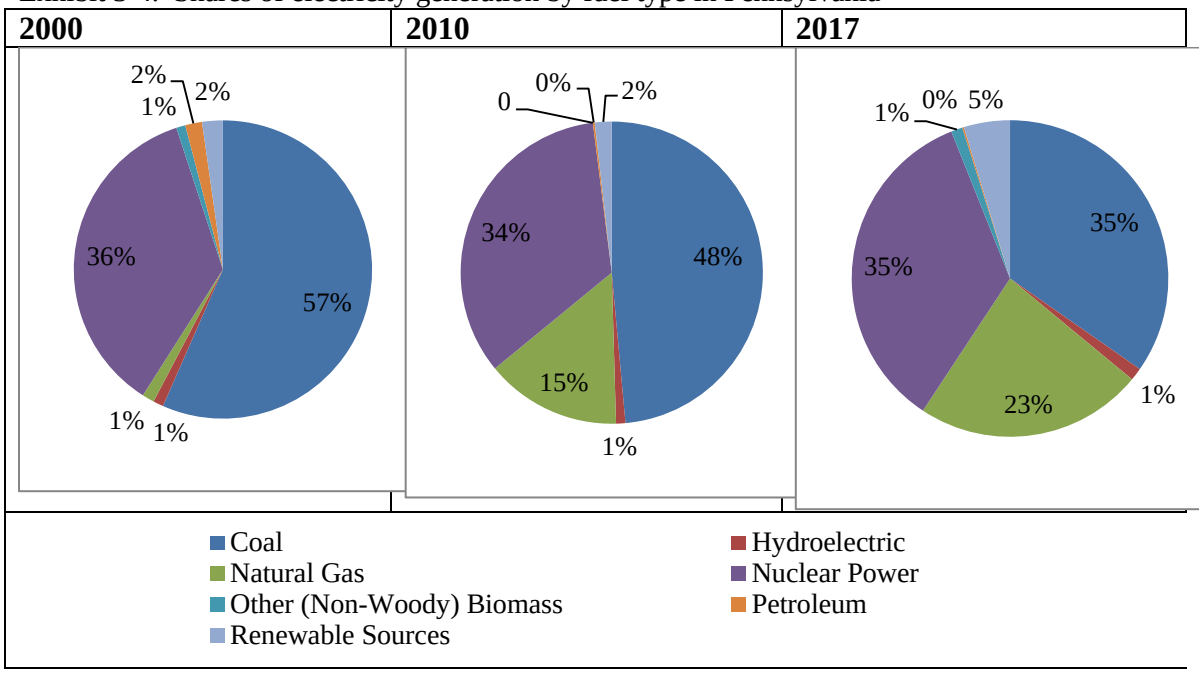
Source: Energy Information Administration

The impacts of these trends in fuel use can be seen in the distribution of electricity generation by fuel type over time. Exhibit 3-4 shows this distribution for 2000, 2010, and 2017. Although the share of Pennsylvania electricity generated by nuclear power plants remains relatively constant at approximately one-third of the total, the shares attributable to coal and natural gas change materially over that 17-year period. Coal, which provided 57 percent of the generated electricity in 2000, shrank to just under half of the total in 2010 and is projected to shrink to 35 percent of the total in 2017. Coal's share is in decline for a number of reasons, including the retirement of facilities with varying capacities. Natural gas, by contrast, represented an insignificant share of the total in 2000, but expanded to 15 percent by 2010. Continued growth in the use of natural gas is expected to result in natural gas accounting for almost one-quarter of the electricity produced in Pennsylvania by 2017.

By that year, coal, nuclear power, and natural gas will contribute an estimated 93 percent of the electricity created in the state, a total similar to that provided by these three fuels in 2000 (94 percent) and 2010 (95 percent). Other fuels will continue to provide a relatively modest share of the total. The share contributed by renewable sources (excluding

hydroelectric and non-woody biomass), however, grows from 2 percent in 2000 to 5 percent in 2017.[26] These distributions are presented over time in Exhibit 3-4.

Exhibit 3-4. Shares of electricity generation by fuel type in Pennsylvania

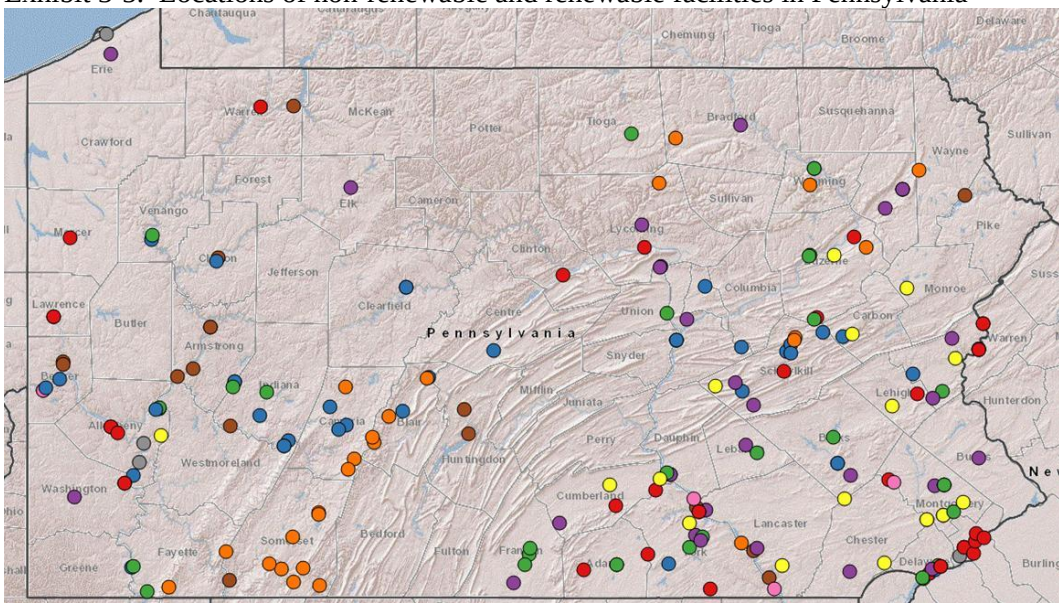


Source: Pennsylvania Public Utility Commission, Energy Information Administration

The map presented as Exhibit 3-5 supplies locational data for electricity generation facilities using both non-renewable and renewable fuel sources. A listing of these facilities as of 2012 is presented at the end of Appendix 3. The table in the Appendix also includes information on additional facilities using other types of renewable fuel sources not shown in Exhibit 3-5. These include commercial and institutional solar thermal facilities, commercial wind farms, and farm and food processing anaerobic digesters and gasifiers. A more detailed discussion on renewable energy occurs in the next section.

[26] The increase in electricity generation from renewable sources will likely derive from different types of renewable sources. Wind, however, is likely to be a dominant source. The increase in generation from 2011 to 2017 needed to meet the 5 percent projection would likely be 4.3 million megawatt hours. The average existing wind facility in Pennsylvania generates 131,000 megawatt hours according to a 2011 listing of 15 wind facilities in Pennsylvania. If this continued to be the average size of a wind facility, an added 33 wind facilities would be needed to reach the 5 percent projection.

Exhibit 3-5. Locations of non-renewable and renewable facilities in Pennsylvania



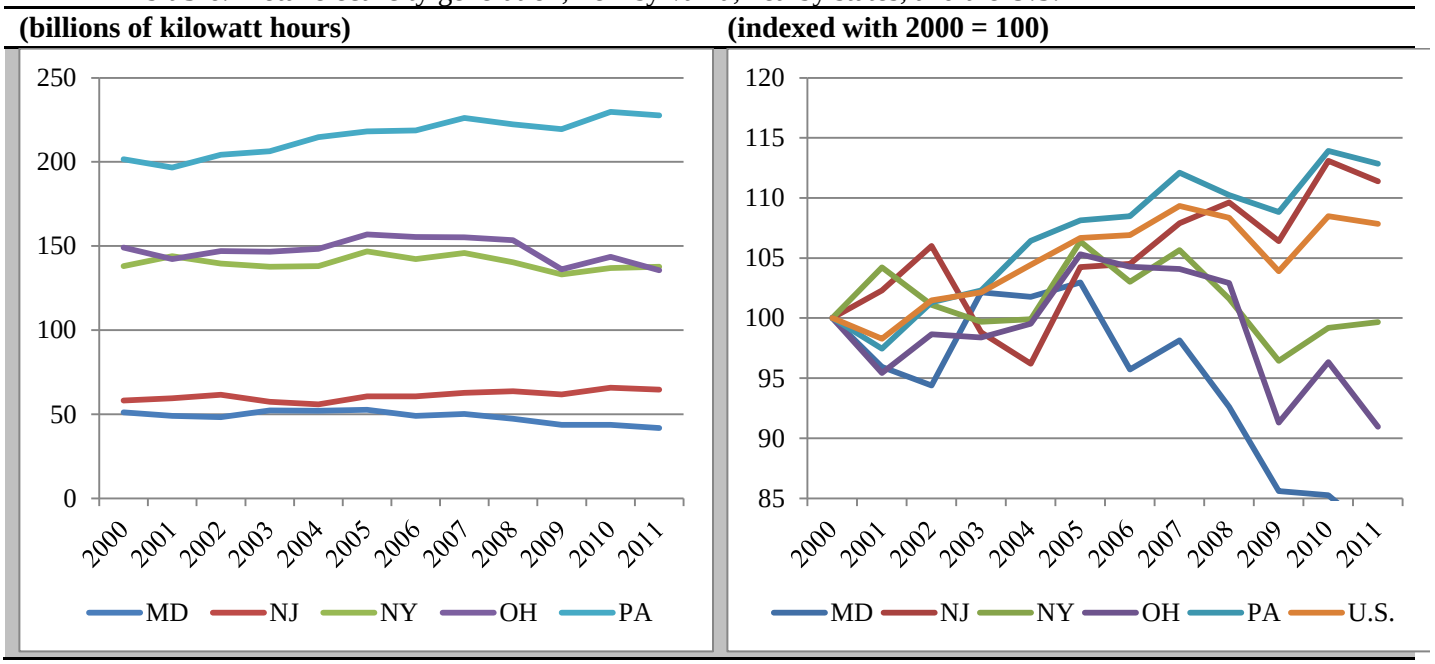
Legend

Oil (41)	Biomass (32)	Water (16)
Coal (36)	Wind (25)	Nuclear (4)
Gas (36)	Solar (17)	Other Nonrenewable (4)

Source: Electric Power Generation Association

Pennsylvania's total generation of electricity is compared to that of nearby states in Exhibit 3-6. As indicated, Pennsylvania generates substantially more electricity than its neighbors. Moreover Pennsylvania has continued to increase its generation over time, showing more relative expansion since 2000 than any of the other states shown in Exhibit 3-6 (although New Jersey has shown almost as much relative expansion). It is worth noting that both Maryland and Ohio have experienced relative decreases in electricity generation since 2000.

Exhibit 3-6. Total electricity generation, Pennsylvania, nearby states, and the U.S.



Source: Energy Information Administration

3.2 Renewable Energy Generation Capacity

In 2004, Pennsylvania established Act 213, the Alternative Energy Portfolio Standard (AEPS), which requires all electric suppliers in the state to provide 18 percent of their energy from advanced or renewable energy sources by 2020.[27] The sources are divided into two tiers. The first tier, to account for 8 percent, includes solar, wind, low-impact hydro, geothermal, fuel cells, biomass, and coal mine methane. The second tier, accounting for the remaining 10 percent, includes distributed generation (personal power), large scale hydropower, waste coal, waste biodigesters, and wood/wood waste.

Over the 11-year period ending in 2011, renewable energy trends in Pennsylvania reflect fuel types associated with increasing and decreasing use over time as well as one steady performer.[28] The relatively steady performer is conventional hydroelectric power. Given the relatively constant nature of water resources, it is perhaps reasonable that hydroelectric would exhibit a modest growth rate (2.4 percent per year on average). The fuels with negative growth were 1) wood/wood waste and 2) waste biodigesters, landfill gas, and other forms of biomass (e.g., biofuels)[29], which shrank at average annual rates of

[27] PennFuture, "Pennsylvania's Advanced Energy Portfolio Standard (AEPS): What Does It Really Mean?" http://www.pennfuture.org/UserFiles/AEPSFactSheetjcfinal1215.pdf

[28] Consistent historic data on the role of renewable energy in electricity generation are available from 2002 to 2010, but not for earlier years.

[29] Although data are available for a few years in the 2000-2010 period for landfill gas (specifically 2010 actual data and more speculative data for 2015 and 2017 as noted in Section 2.6, above), time series data

0.8 percent and 1.1 percent, respectively. The most progress was made by wind power, which increased 68.9 percent annually between 2000 and 2010.

A renewable fuel source that emerged in the 1980s is the conversion of coal refuse. A downside of the state being such a large coal producer is that coal that is undesirable for the market place has and does accumulate across the landscape in Pennsylvania, which can have potentially harmful environmental impacts. In response, there has been a concerted effort by public and private investors to find a solution to the accumulating 'coal refuse'. Some electric generating plant facilities remove and convert coal refuse from both past and current mining activities to produce alternative energy. There are 17 such facilities operating in Pennsylvania and West Virginia with a combined capacity of nearly 1,600 megawatts, or 3 to 5 percent of the renewable energy total generated by the two states.[30] Alternative energy plants remove and convert over 189 million tons of coal refuse restoring over 6,700 acres of damaged mine lands of miles of degraded streams.[31]

Another renewable fuel source, solar energy, only began to contribute to the grid in 2008 and represents a minute share of the renewable generation total (0.3 percent) as of 2011. Prompted by AEPS, Pennsylvania's Alternative Energy Investment Act passed in 2008 set aside $180 million for solar deployment.[32] It is important to note that some of the solar energy generated in the state does not feed directly into the grid. In addition, although solar generation still represents a minimal percentage of overall generation, installed capacity has grown significantly over the past few years. These trends are reflected in Exhibit 3-7. Goals for solar utilization can be met, with the underlying presumption being that technological progress will be swift and incentives to turn to solar energy will be pervasive.

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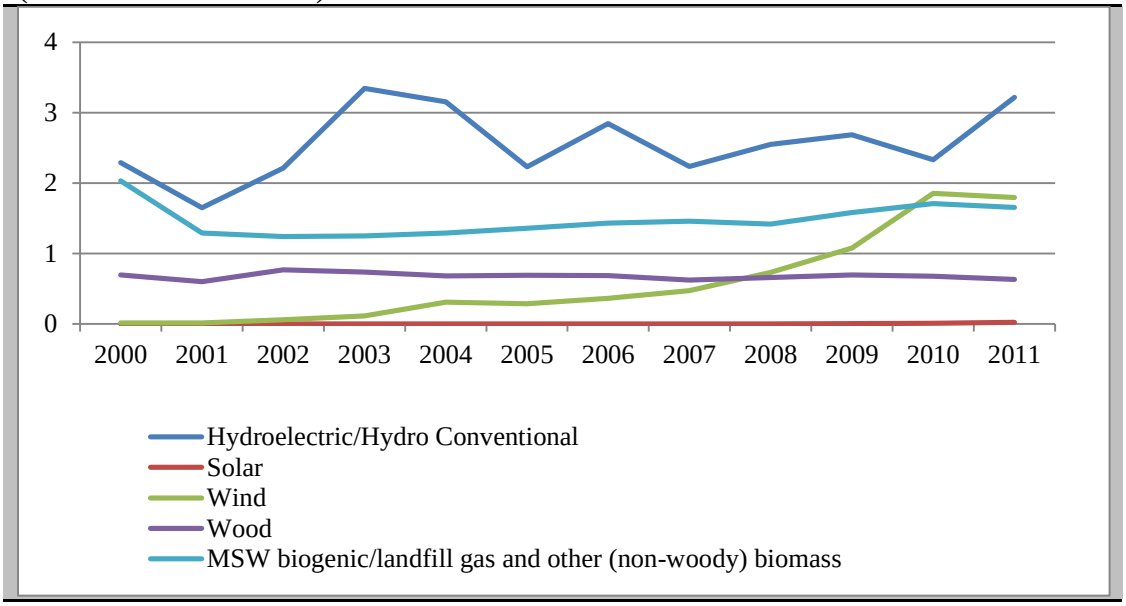
for the individual components of the MSW biogenic/landfill gas and other biomass are not available for the 2000 to 2017 period. These data are only available for the period of interest for these renewables as a group.

[30] McNelly, Jeff A. Issue brief. Camp Hill: Anthracite Region Independent Power Producers Association (ARIPPA), 2012. Print.

[31] ARIPPA. Alternative Energy Plants Remove and Convert Over 189 Million Tons of Coal Refuse Restoring Over 6,700 Acres of Abandoned Mine Lands and Miles of Degraded Streams. N.p., 2012.

[32] Mulligan, Maureen and Ron Celentano. Pennsylvania Solar Energy Industries Association, 2/4/2013. Print.

Exhibit 3-7. Electricity generation trends by renewables
(billions of kilowatthours)



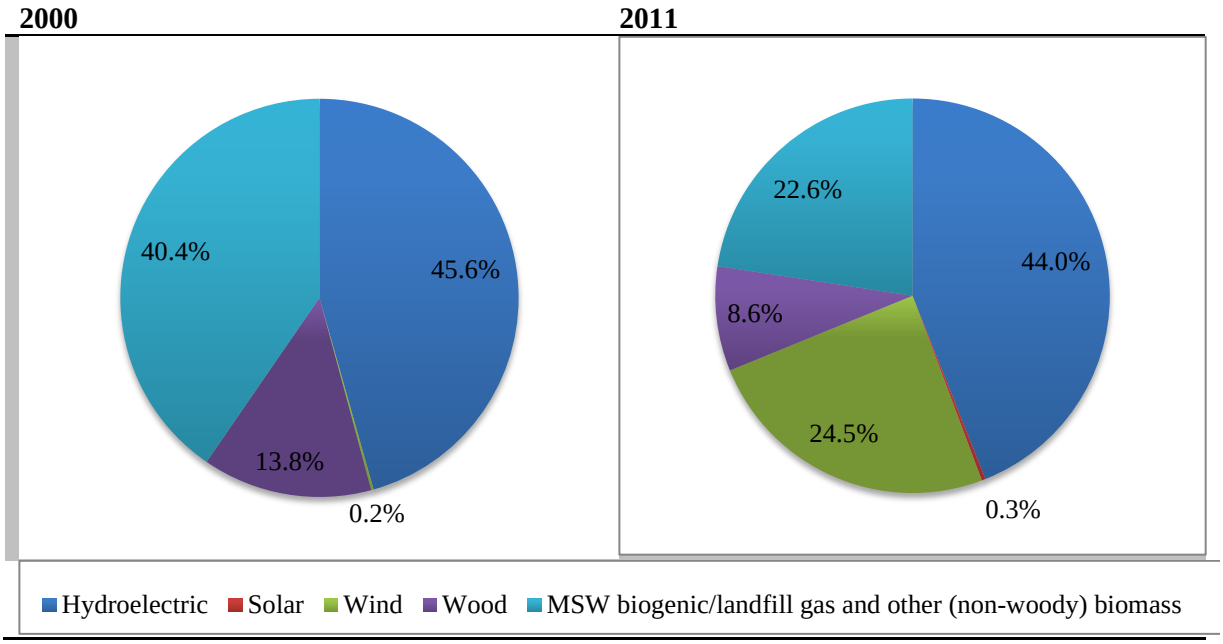
Source: Energy Information Administration

Exhibit 3-8 converts trends in the roles of renewable energy in the generation of electricity to shares of total power attributable to each of the types of renewable energy in 2000 and 2011, respectively. Hydroelectric power in each year represents the primary source of renewable energy. Nevertheless, within that 11-year period, its share of all electricity generation by renewables decreased from 46 percent to 44 percent. Waste biodigesters/landfill gas also lost share, slipping from 40 percent of the 2000 total to 23 percent in 2011. The role of wood and biomass was also curtailed from 14 percent to 9 percent of the total. These losses are entirely attributable to growth in the status of wind power, which in 2011 accounted for 25 percent of all electricity generated by renewable energy, the second most common source of this category of electricity.

Based on these trends, the ongoing installation of new wind capacity is likely to result in wind generation exceeding hydroelectric production over the next few years unless substantial hydropower capacity is added. The addition of this level of hydropower is unlikely. Solar, which did not contribute to generation at all in 2000, represented 0.3 percent of the total in 2011.

In 2000, renewable sources contributed an estimated 5.0 million megawatt hours of electricity generation in Pennsylvania. By 2011, the volume of electricity generated by renewable sources increased to 7.4 million megawatt hours.

Exhibit 3-8. Distribution of renewable electricity generation in Pennsylvania by type



Source: Energy Information Administration

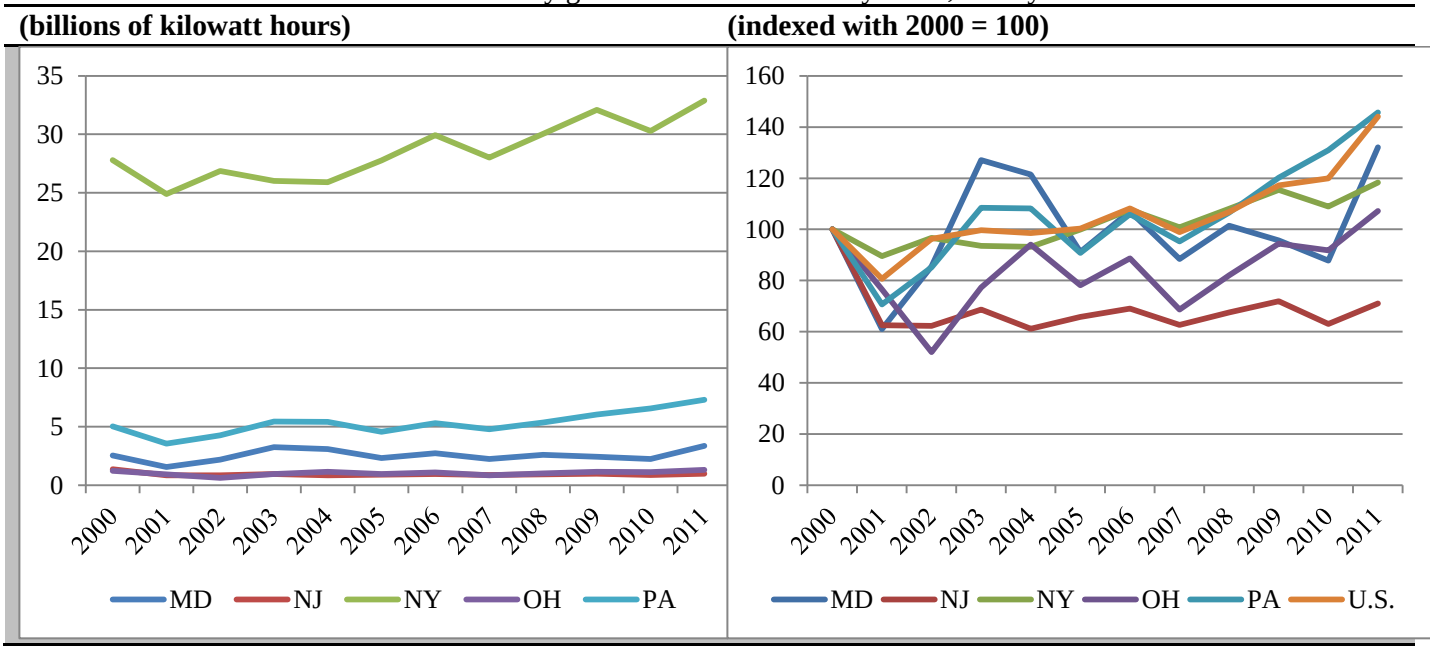
Exhibit 3-5 provides locations of renewable energy power plants in the state. There is some tendency for plants to cluster by fuel type. For instance, the majority of hydroelectric plants are in western Pennsylvania. The southwestern portion of the state is associated with a concentration of wind farms. Alternatively, biomass facilities are predominantly located in the eastern half of the state. Topography and natural resources can also be important locational factors. Renewable facilities in Pennsylvania as of 2012 are listed at the end of Appendix 3.

Pennsylvania's experience with the generation of electricity by renewable fuel sources is compared to that of nearby states in Exhibit 3-9. The comparison is made on the basis of total generation by all renewables and in terms of growth in generation from 2000 by indexing each state's generation to that year.

As shown, New York is the clear leader in the volume of generation by renewable sources. As much as 93 percent of New York's volume of generation from renewables since 2000 is attributable to hydroelectric power. If this factor were not considered, New York's experience would look much more similar to that of Pennsylvania's.

In relative terms using year 2000 as an indexing point, Pennsylvania has increased its output of electricity generated by renewable sources more substantially than any of the nearby states and at about the same overall pace as the nation as a whole. Other nearby states have expanded generation from renewable sources at a slower pace or, in the case of New Jersey, generated less electricity over time from renewable sources despite a recent uptick in the state's solar energy market.

Exhibit 3-9. Total renewable electricity generation trends: Pennsylvania, nearby states and US



Source: Energy Information Administration

3.3 Renewable Energy Economic Characteristics

Providing an in-depth economic profile for renewables is challenging given that the industry remains small and production is generally of relatively recent origin. The federal Bureau of Labor Statistics (BLS) conducts an annual Green Goods and Services (GGS) survey of 120,000 business establishments that measures employment associated with the 'green jobs'. Specifically, among the industries included in BLS' definition of 'green' electric power generation jobs are nuclear power, hydroelectric power, biomass, sunlight, wind, and other renewable sources. Nationally, these jobs totaled just over 44,000, which accounted for approximately 11 percent of total electric power-related jobs at the end of 2010.[33] Unfortunately, BLS does not breakout these data on the state level.

The good news is that with Pennsylvania's expanding renewable energy industry, which is tied to the current implementation efforts of all AEPS requirements, data on a local level are becoming increasingly available through the collection efforts of local organizations and national renewable energy interest groups.

Some recently reported data are promising. For example, the Pennsylvania Department of Labor and Industry projected 'green jobs' in the state to grow from approximately

[33] Bureau of Labor Statistics. "Green Goods and Services News Release." (March 22, 2012). http://www.bls.gov/news.release/ggqcew.htm

183,000 in 2010 to over 206,000 in 2012, a 6 percent growth rate.[34] In addition, the Solar Foundation's National Solar Jobs Census estimated the number of solar jobs in Pennsylvania at 6,700.[35]

Data on Pennsylvania's wind industry show that the state's investment in wind power produced between 3,000 and 4,000 jobs in 2011 and resulted in $3.7 million in new fiscal impacts for state and local governments through the collection of new property and land lease taxes. The reason for this growth has to do with the fact that many of the skills already obtained by Pennsylvania manufacturing workers easily transfer to wind energy manufacturing. The insurgence of new workers in the industry has also spurred wind-specific investment. For example, a global wind turbine manufacturer, Gamesa, chose Pennsylvania as its American hum and now employs over 800 workers in its manufacturing and sales division.[36]

Finally, Pennsylvania's nuclear power industry also contributes to the local and state economy. The state's nine reactors account for nearly 5,000 jobs annually, which results in approximately $470 million in annual business activity. The sites contribute more than $45 million annually in local and state tax revenues.[37]

3.4 Electric Power Generation Capacity

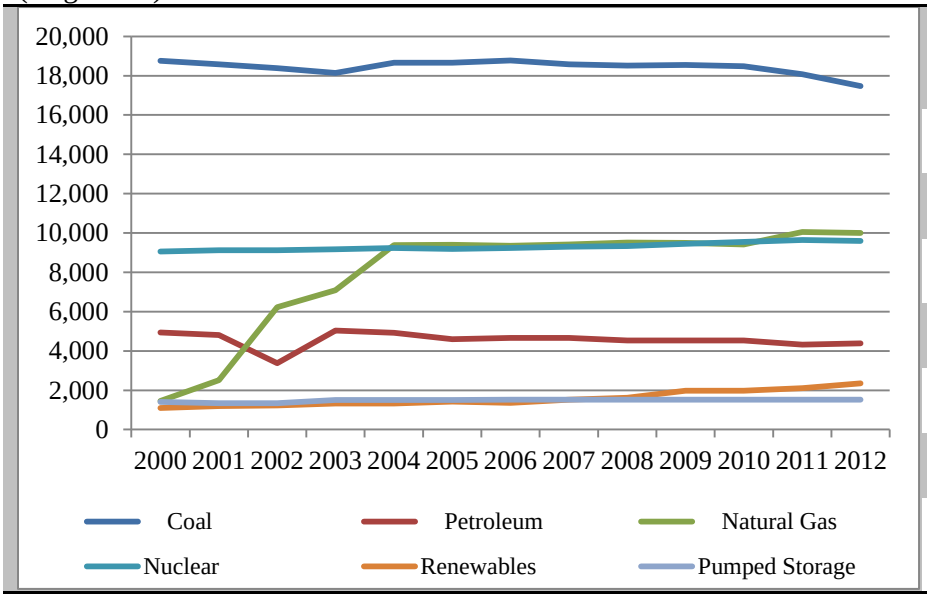
Electric generation capacity, the nominal ability of power plants to produce electricity, shifts as new plants or other generating entities such as wind farms are built and come into service or are retired and taken off-line. This change in capital assets occurs more slowly than does the generation of electricity, which can shift from one existing plant to another as the need for power changes within a year and even within a day.

Exhibit 3-10 graphically presents trends in generation capacity between 2000 and 2012. Significant changes in capacity tended to occur between 2000 and 2004 when natural gas-fired capacity grew dramatically. This surge was a result of several decades of economic change.[38] After 2004, the average annual growth rate for all fuel types other

[34] Pennsylvania Public Utility Commission and Pennsylvania Department of Environmental Protection. (August 2011). *2010 Annual Report: Alternative Energy Portfolio Standards Act of 2004.*
[35] Ibid.
[36] American Wind Energy Association. "Wind Energy Facts: Pennsylvania."
[37] Pennsylvania Energy Alliance.
[38] The reasons for the surge in capacity between 2000 and 2004 can be traced at least to the 1960s and 1970s. Substantial and sustained growth at that time led to a major expansion of capacity. A worldwide economic downturn and recession in the early 1980s then reversed this growth in demand and was followed by a long period from the mid-1980s to 2000 when no new plants were built because Pennsylvania had excess capacity. By the early 2000s when demand for electricity reemerged, plants from the 1960s and 1970s were old, at the end of their useful lives, and often unable to meet then current environmental

than renewables, which account for a modest share of the total, dropped to less than 1 percent. After a significant dip in capacity 2002 and a rebound in 2003, capacity provided by petroleum steadily decreased. The exception to this rule of very limited growth is renewables, which grew almost 7 percent per year on average from 2000 to 2012.

Exhibit 3-10. Pennsylvania electricity generation capacity trends
(megawatts)



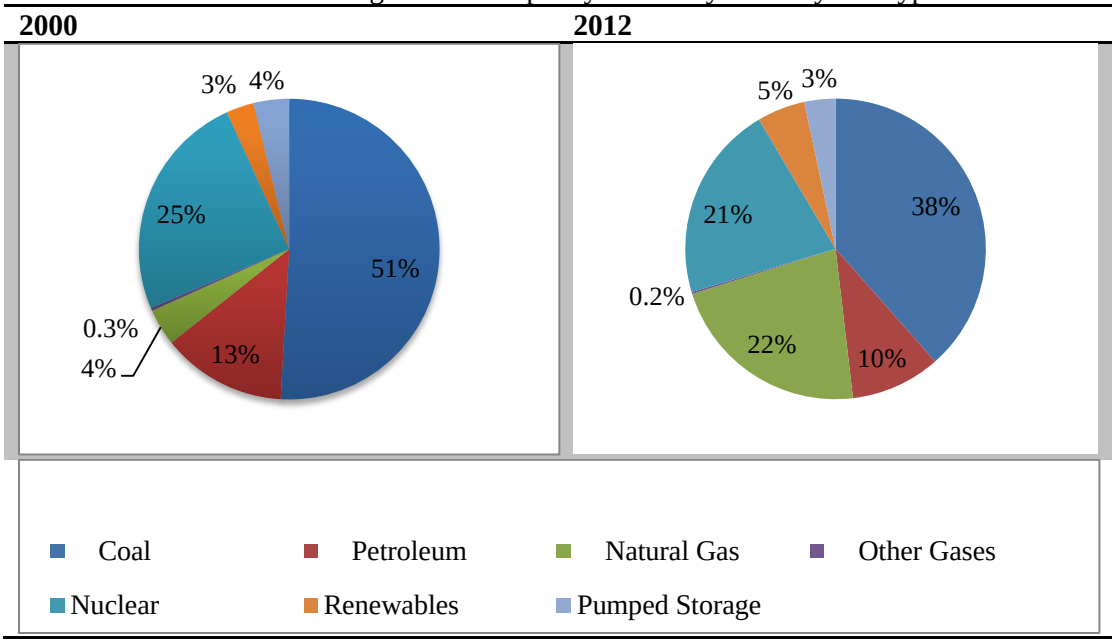
Average annual growth rate	
Coal	-0.6%
Petroleum	-0.1%
Natural Gas	17.4%
Other Gases	-1.4%
Nuclear	0.5%
Renewables	6.6%
Pumped Storage	0.6%

Source: Energy Information Administration, PJM Interconnection

The impact of these trends on the distribution of generation capacity by fuel type is shown in Exhibit 3-11. In relative terms, most changes from 2000 to 2012 are not substantial.

standards. See "Electric power outlook for Pennsylvania: 2002-2007," Pennsylvania Public Utility Commission, August 2003 page 55.

Exhibit 3-11. Distribution of generation capacity in Pennsylvania by fuel type



Source: Energy Information Administration, PJM Interconnection

The biggest absolute changes are in the shares of coal, which decreased 13 percentage points, and natural gas, which rose by 18 percentage points. More, typically older, coal-fired power plants are expected to retire in the coming years likely reflecting the state's growing use of more modernized natural gas generating facilities. Over 2,100 megawatts of coal-fired generating facilities have already been deactivated and another approximately 1,200 megawatts are scheduled to be retired after calendar year 2012. Exhibit 3-12 provides plant- and county- level detail of both recent and planned deactivations.

Exhibit 3-12. Recent and planned coal facility closures in Pennsylvania

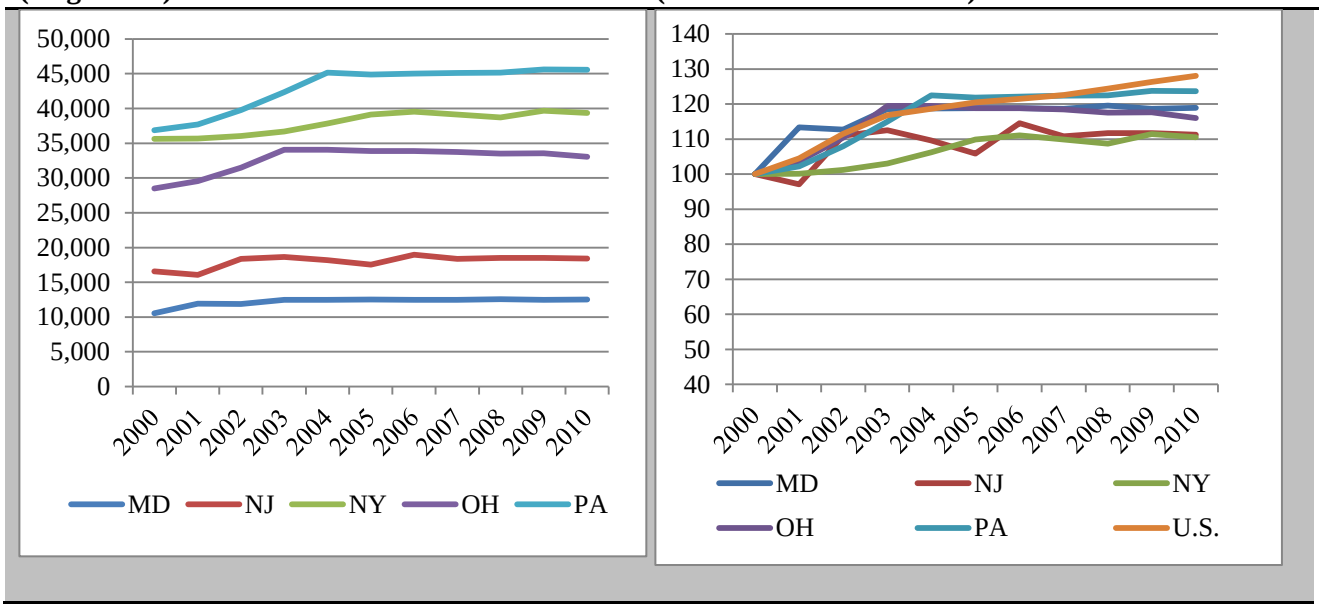
Plant	Unit(s)	County	MWs	Fuel Type
Recent Deactivations				
Elrama	1-4	Washington	460	Coal
New Castle	3-5	Lawrence	326	Coal
Armstrong	1, 2	Armstrong	343	Coal
Eddystone	1, 2	Delaware	588	Coal
Cromby	1, 2	Chester	345	Coal
Hunlock	9	Luzerne	45	Coal
Planned Deactivations:				
Portland	1, 2	Northampton	401	Coal
Titus	1-3	Berks	243	Coal
Shawville	1-4	Clearfield	597	Coal
Total			**3,348**	

Source: EPGA

While renewables capacity grew at the fastest rate of any fuel type during this period, the actual share of total capacity for renewables only increased from 3 percent to 5 percent, which represents a substantial relative gain, but not necessarily one in absolute terms. The surge in the use of natural gas is also the most likely explanation for substantial reductions in the share attributable to nuclear (decreasing from 25 percent to 21 percent) and petroleum (decreasing from 13 percent to 10 percent).

Generating capacity in Pennsylvania is compared to capacity in nearby states in Exhibit 3-13. As shown, Pennsylvania generating capacity is significantly larger than that of nearby states. Since 2000, Pennsylvania has also expanded capacity at a rate somewhat higher than that of these states and at a rate similar to that of the nation as a whole.

Exhibit 3-13. Total net summer generation capacity: Pennsylvania, nearby states and US



Source: Energy Information Administration

3.5 Electric Power Generation Economic Characteristics

The Electric Power Generation Association (EPGA) conducted an industry survey in 2012, which asked generation companies in Pennsylvania to identify the number of employees that directly participated in the production of electrical power, the marketing (wholesale) of their electrical power, and the selling (wholesale) of their electrical

power. Each company made the requisite calculations and in the aggregate members of EPGA employ over 20,000 Pennsylvanians to discharge such duties.[39]

Another indication of the distribution of this electricity generation employment within Pennsylvania is available from the Pennsylvania Department of Labor and Industry, which provides county-level data for employment in the electrical utility industry. The employment data in Exhibit 3-14 includes not only generation, but also transmission, control, and distribution. The data are for employment in the first quarter of 2009.[40]

Exhibit 3-14. Ten counties with highest electric utility employment, Pennsylvania

Montgomery County	2,202
Allegheny County	2,049
Beaver County	1,844
Luzerne County	1,556
York County	1,246
Philadelphia County	1,237
Indiana County	936
Dauphin County	892
Berks County	782
Chester County	603

Source: Pennsylvania Department of Labor and Industry

Exhibit 3-15 provides a county-level summary of power generation business establishments in Pennsylvania. The data in Exhibit 3-14, derived from Platts' annual business inventory publication, differ slightly from the data used to generate the map in Exhibit 3-5 due to differences in EPGA survey methodology.

[39] Electric Power Generation Association presentation by President Douglas L. Biden before the Consumer Affair Committee, Pennsylvania House of Representatives, February 10, 2011

[40] Pennsylvania Department of Labor and Industry. "Industry Employment Distribution, Sector (2 digit) Utilities industry." Available at http://paworkstats.geosolinc.com/vosnet/lmi/industry/industrysummary.aspx?session=inddetail&section=indempdata&geo=4201000000&naicscode=22.

Exhibit 3-15. Electric power generation business establishments in Pennsylvania by county, 2012

County	*# of Plants*	*County*	*# of Plants*	*County*	*# of Plants*
Adams	5	Franklin	2	Schuylkill	7
Allegheny	6	Huntingdon	1	Snyder	1
Armstrong	1	Indiana	5	Somerset	1
Beaver	3	Lackawanna	2	Susquehanna	1
Berks	4	Lancaster	4	Tioga	1
Bucks	2	Lebanon	2	Union	1
Cambria	4	Lehigh	9	Venango	2
Carbon	1	Luzerne	3	Warren	1
Clarion	1	Lycoming	2	Washington	1
Columbia	1	Mercer	1	Wayne	1
Dauphin	3	Montgomery	4	Westmoreland	2
Delaware	5	Montour	1	Wyoming	1
Elk	2	Northampton	8	York	8
Erie	3	Northumberland	2	Outside of PA	1
Fayette	3	Philadelphia	5		
				PA-Statewide	**119**

Source: Platts, 2013 UDI Who's Who at Electric Power Plants, 23rd Edition

Finally, the Edison Electric Institute conducted an economic and fiscal impact study of the electric power industry's contribution to the Pennsylvania economy in 2010. In total, the industry had a $22.9 billion impact on the state's economy. This total represents estimates of direct, indirect, and induced activity. The study showed that the electric power industry supported a total of almost 70,000 jobs, approximately 16,500 direct jobs and over 53,000 indirect and induced jobs. From a fiscal standpoint, the industry paid over $2.8 billion in local, state, and federal taxes. A detailed breakdown of impacts in Pennsylvania is provided in Exhibit 3-16 below.

Exhibit 3-16. Electric power industry economic and fiscal impacts in Pennsylvania, 2010

Employment (1)	
Direct (electric power generation, transmission, distribution)	16,532
Indirect (suppliers)	21,675
Induced	31,709
Total Employment	*69,917*

Estimated Tax Revenues (2) (billions of dollars)	
Federal Taxes	$1.1
State and Local Taxes	$1.7
Total	*$2.8*

Notes: (1) Full time equivalent (FTEs) employees
(2) Direct, Indirect, and Induced Taxes

Source: Edison Electric Institute

4.0 Imports and Exports

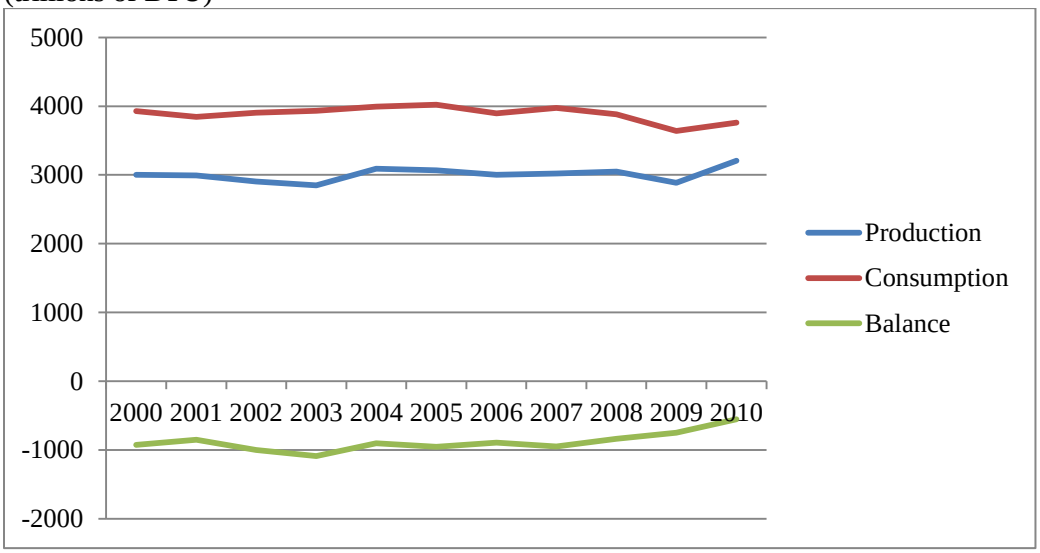
Energy is fungible and tends to ignore political boundaries. For virtually all types of energy, Pennsylvania is both an exporter and importer. To determine the extent to which the state is ultimately producing enough energy to meet its own needs, the following discussion focuses on state-based production and state-based consumption. Cross-border flows of energy or additions or deletions to stored inventories of some types of energy (e.g., natural gas) are ignored in favor of fundamental levels of production and consumption. In addition to total energy, this chapter addresses the three most significant primary types of energy in Pennsylvania--natural gas, coal, electricity, and to a smaller extent crude oil. The state is a net exporter of these three types of energy. Like most states, Pennsylvania is a net importer of petroleum products making it a net importer of energy in the aggregate.

4.1 Total Energy Production and Consumption

In these terms, Pennsylvania has historically been a net importer of energy. From 2000 through 2010, Pennsylvania consumed roughly 4 quadrillion BTU of energy while producing roughly 3 quadrillion BTU. The greatest shortfall in this period occurred in 2005, when consumption exceeded production by 1.3 quadrillion BTU.

As Exhibit 4-1 indicates, since 2007, there has been a steady narrowing of this gap. As a result of both decreasing consumption and expanding production, the shortfall in production (i.e. the need to import energy) has been reduced to 0.7 quadrillion BTU (as of 2010).

Exhibit 4-1. Total energy production and consumption: 2000 – 2010, Pennsylvania (trillions of BTU)

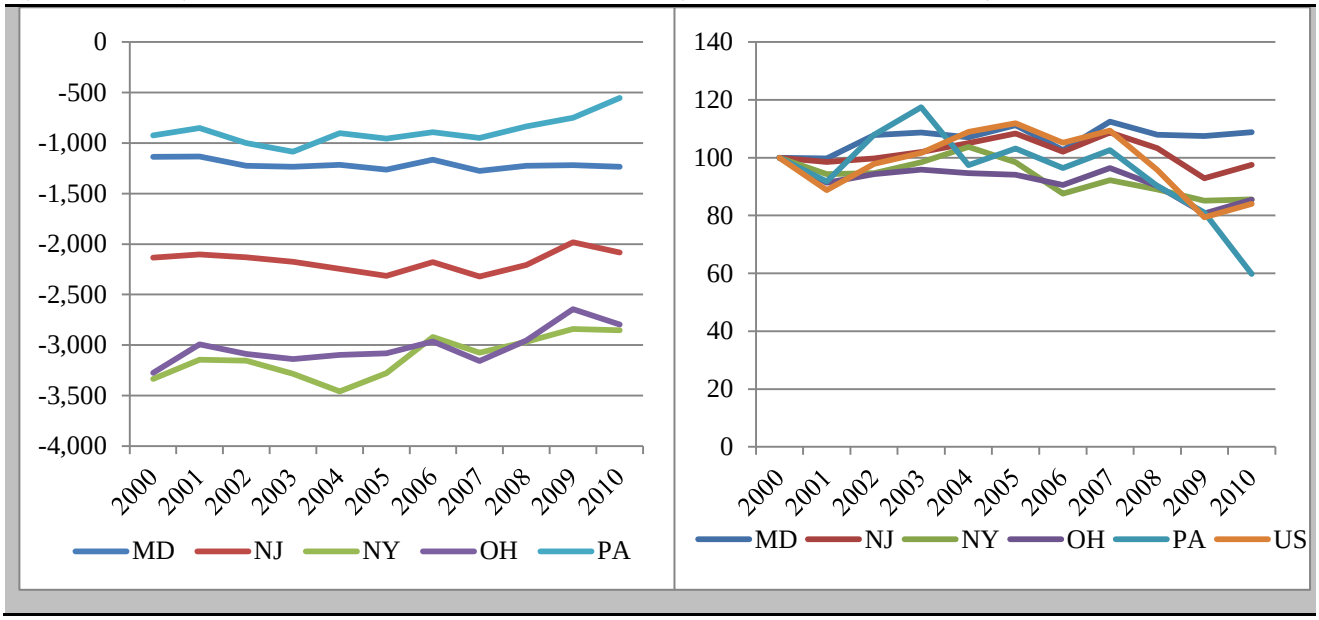


Sources: Energy Information Administration, Pennsylvania Department of Environmental Protection

Exhibit 4-2 provides a comparison of the balance of total energy production and consumption for Pennsylvania and nearby states. As shown, all states consume more energy than they produce. Nevertheless, the deficit for Pennsylvania is smaller than that of any of the other states.

Because all states in Exhibit 4-2 are net energy importers, they all have deficits when total energy production and consumption are taken into account. As a result, when the performance of these states is indexed, the most desirable trend is to reduce that deficit over time. For the index this means moving from higher to lower values where such movement represents progress in reducing a state's energy deficit. Pennsylvania stands out in this regard. The impact of existing Marcellus Shale-related production is reflected in the dramatic downturn in Pennsylvania's index trend line from 2007 to 2010. By 2010 Pennsylvania had done more than any of other states shown in the exhibit to reduce its 2000 energy deficit.

Exhibit 4-2. Total energy balance of production and consumption: Pennsylvania, nearby states and US

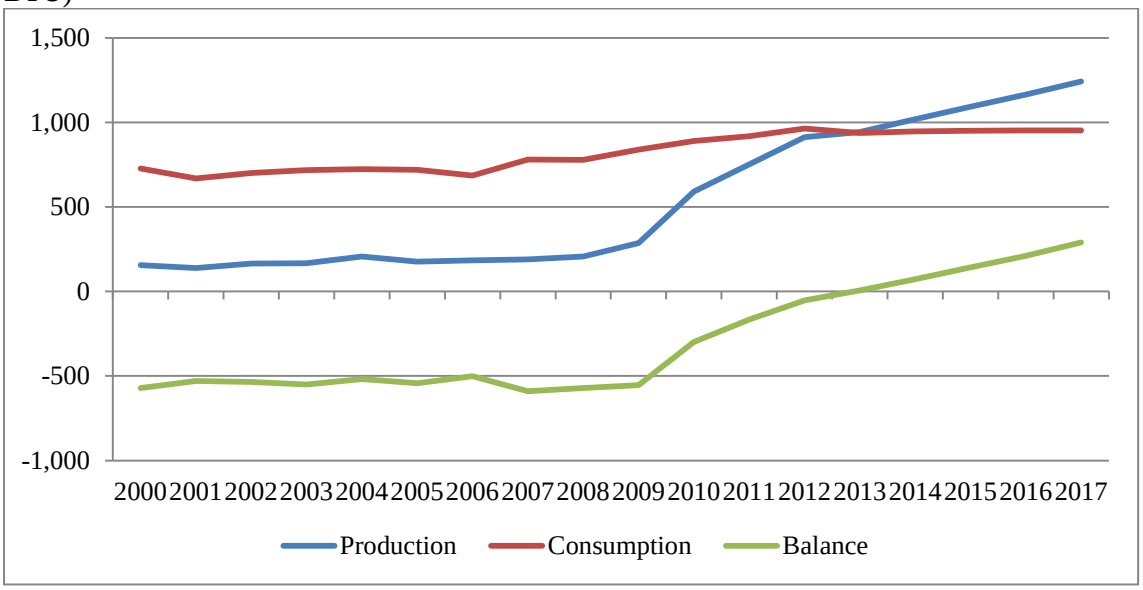


Sources: Energy Information Administration, Pennsylvania Department of Environmental Protection

4.2 Natural Gas Production and Consumption

The primary factor in this narrowing of the gap between total energy consumption and production has been trends in natural gas production. From 2000 to 2009, consumption was relatively stable, fluctuating between 0.6 quadrillion BTU and 0.8 quadrillion BTU. For most of that period, production stayed at or below 0.2 quadrillion BTU. As a result, Pennsylvania needed to import between 0.5 quadrillion BTU and 0.6 quadrillion BTU between 2000 and 2009. In 2010 natural gas from the Marcellus Shale began to increase production volumes dramatically. In that year, the shortfall of state-based production was 0.3 quadrillion BTU or roughly half of the 2009 shortfall. Rapidly increasing production is expected to reduce this shortfall to nearly zero in 2013. Thereafter, production should exceed consumption by ever increasing margins. By 2017, natural gas production in Pennsylvania is expected to exceed consumption by 0.3 quadrillion BTU as shown in Exhibit 4-3.

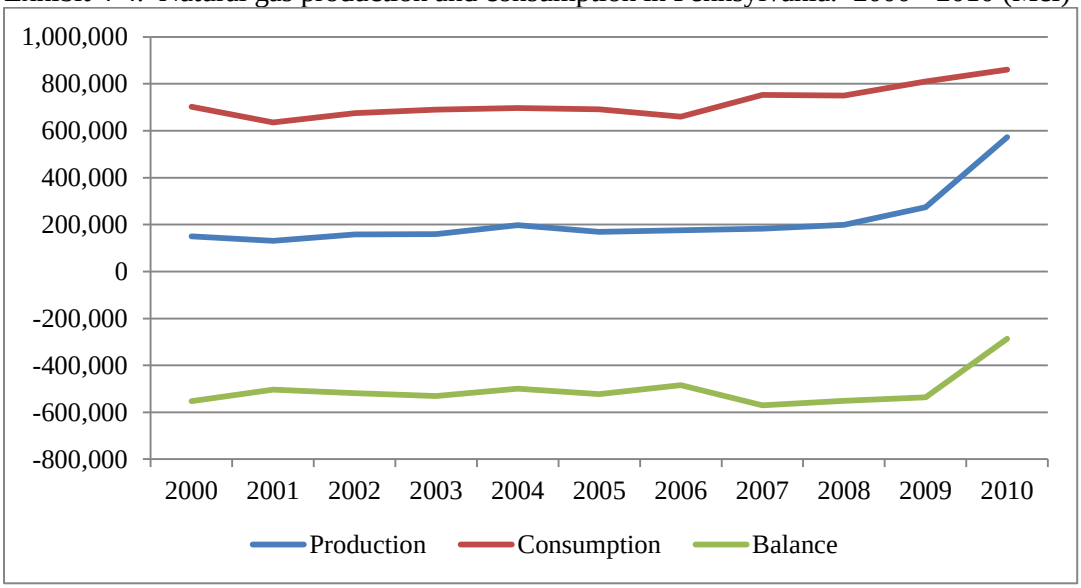
Exhibit 4-3. Natural gas production and consumption in Pennsylvania: 2000 - 2017 (trillions of BTU)



Source: Energy Information Administration

Exhibit 4-4 presents production and consumption data for natural gas in physical units for the period 2000-2010. The dramatic effects of Marcellus Shale production are evident as production rises dramatically in 2009 leading to a shrinking need for importing natural gas.

Exhibit 4-4. Natural gas production and consumption in Pennsylvania: 2000 - 2010 (Mcf)

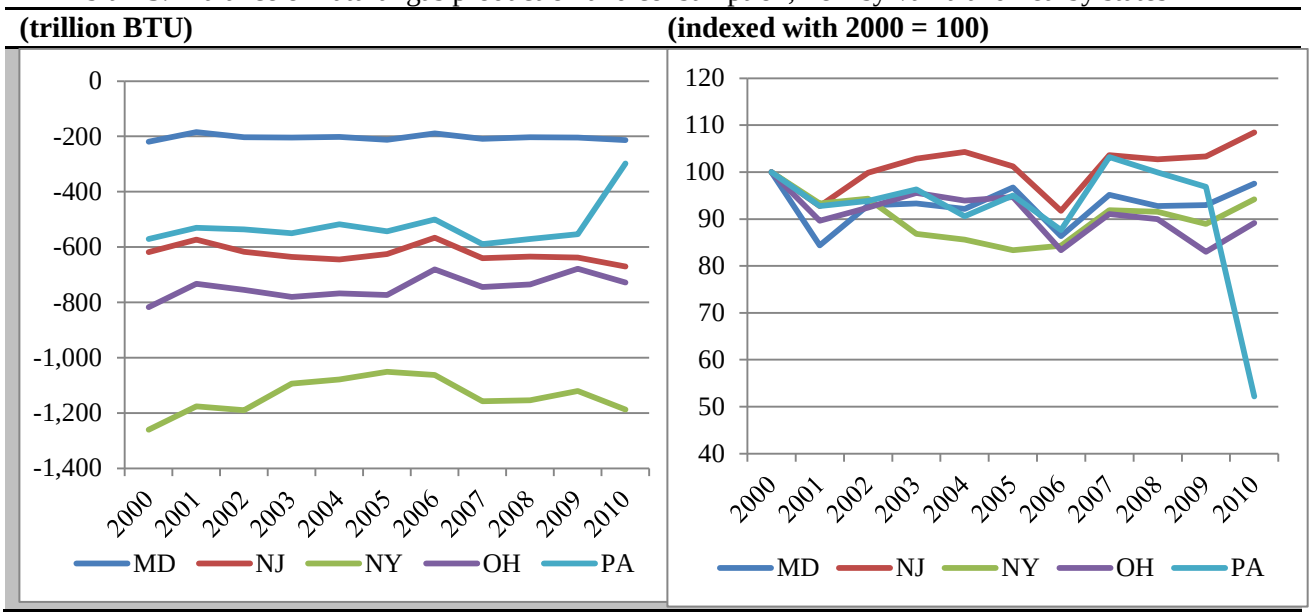


Source: Energy Information Administration

Exhibit 4-5 compares the balance of natural gas production and consumption in Pennsylvania with those of nearby states. Pennsylvania is the only state with a

substantial change in its balance of production and consumption. Again this is the impact of existing Marcellus Shale-related production. Maryland with the lowest population of any of the states presented in the exhibit also has the smallest deficit in natural gas production relative to consumption.

Exhibit 4-5. Balance of natural gas production and consumption, Pennsylvania and nearby states



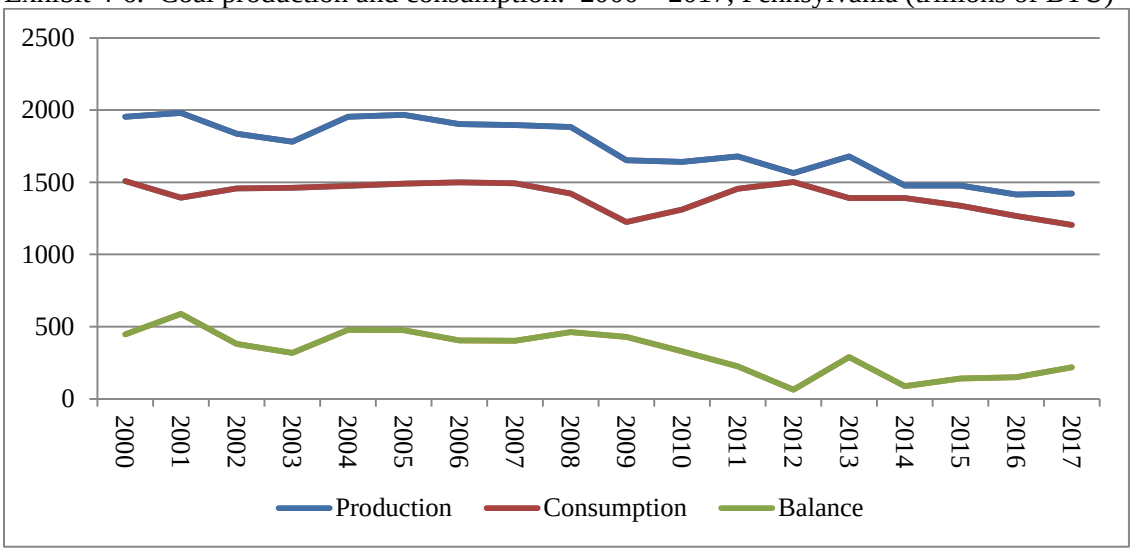
Source: Energy Information Administration

4.3 Coal Production and Consumption

Coal presents a set of trends that are working in the opposite direction of trends characterizing natural gas. Coal production has been decreasing over time and is projected to continue that decline, although it has continued to exceed consumption by a substantial margin. Consumption has been relatively stable and derives almost equally from both Pennsylvania and non-Pennsylvania sources. In the first quarter of 2011, 55 percent of consumption was from in-state producers (24.3 million short tons) and 45 percent was from out-of-state producers (20 million short tons).

Overall, as of 2011, Pennsylvania-specific coal production and consumption nearly reached equilibrium. In the short-term future, coal production will essentially keep pace with consumption. This is reflected in Exhibit 4-6.

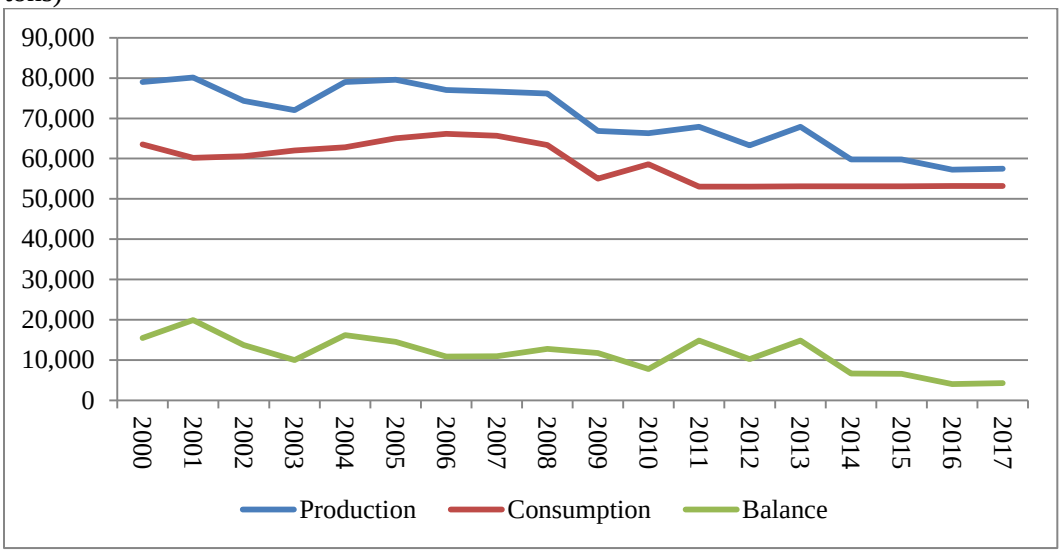
Exhibit 4-6. Coal production and consumption: 2000 – 2017, Pennsylvania (trillions of BTU)



Sources: Energy Information Administration, Pennsylvania Department of Environmental Protection, 2011 Historic Annual Report

Exhibit 4-7 presents production and consumption data for coal in physical units. In 2000, coal production exceeded consumption by almost 15 million short tons. By 2017, production levels are expected to exceed consumption by roughly 6 million short tons.

Exhibit 4-7. Coal production and consumption in Pennsylvania: 2000 - 2010 (thousand short tons)

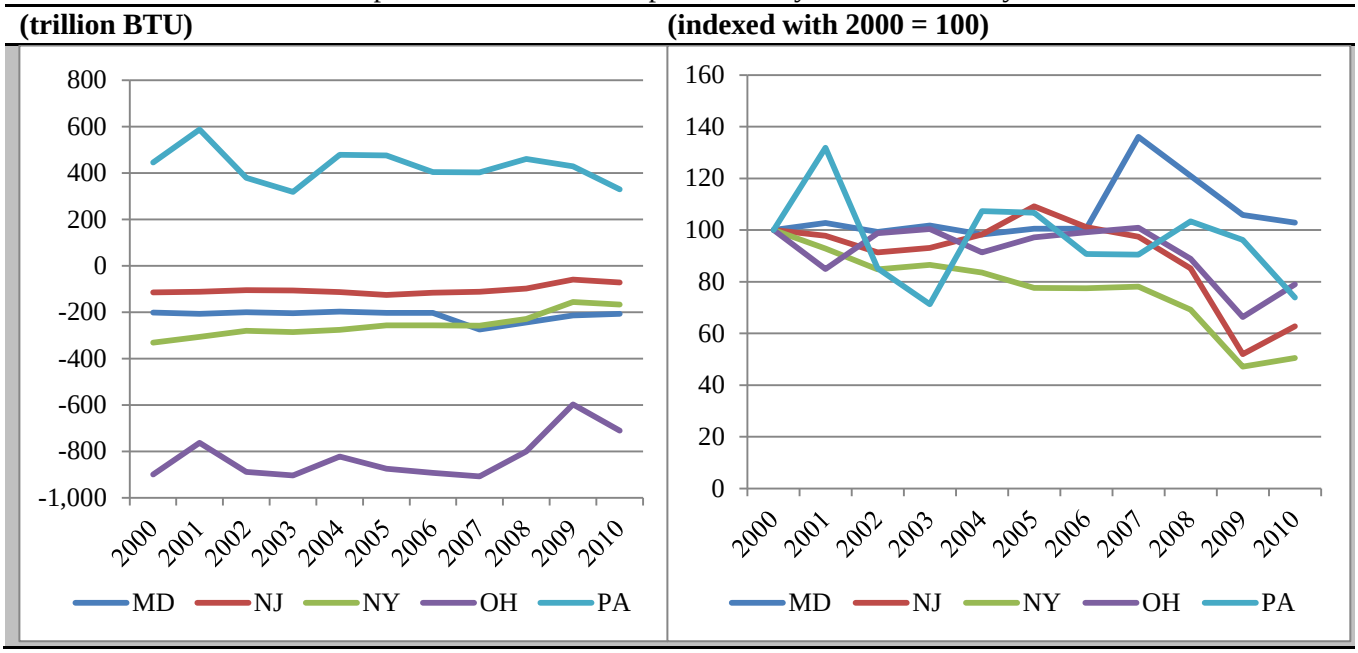


Sources: Energy Information Administration, Pennsylvania Department of Environmental Protection 2011 Historic Annual Report

Exhibit 4-8 compares the balance of coal production and consumption in Pennsylvania with those of nearby states. Pennsylvania is the only state among those shown that has been a net exporter of coal at any time from 2000 to 2010 and the state among those in

the exhibit that has shown the greatest swings in gap between production and consumption in Pennsylvania has had a surplus of almost 600 trillion BTU in 2001 shrinking to just over 300 trillion in 2010; however, Pennsylvania's ratio of production to consumption still far outpaces neighboring states, which are all running at a deficit.

Exhibit 4-8. Balance of coal production and consumption, Pennsylvania and nearby states

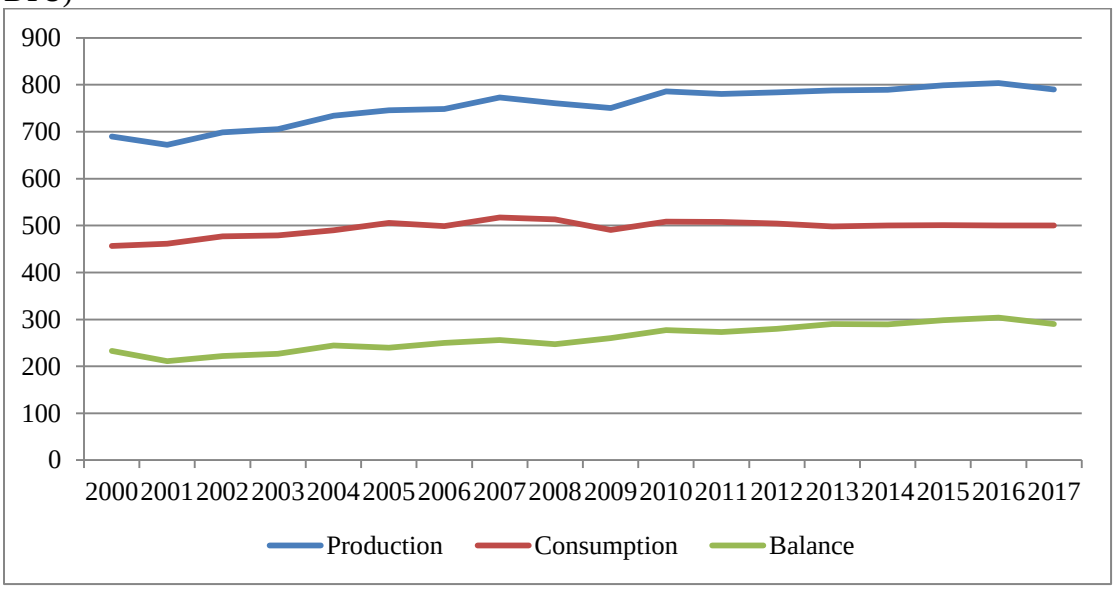


Sources: Energy Information Administration, Pennsylvania Department of Environmental Protection 2011 Historic Annual Report

4.4 Electricity Production and Consumption

The case of electricity is one of relatively stable production and consumption with production exceeding consumption by at least 200 trillion BTU. Gradual increases in production have run parallel with gradual increases in even more modest increases in consumption. By 2017, production is expected to exceed consumption by 300 trillion BTU as indicated by Exhibit 4-9.

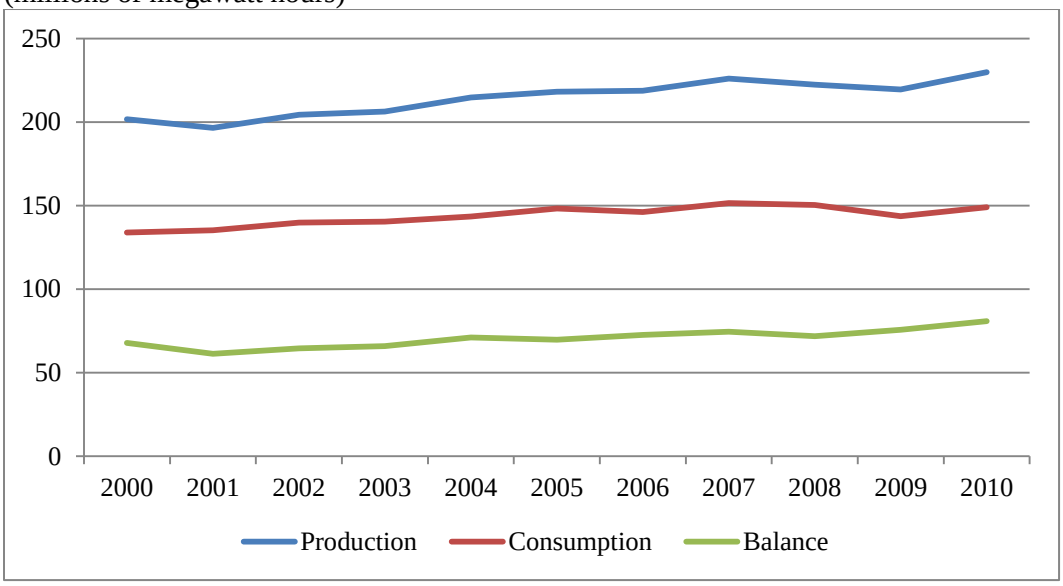
Exhibit 4-9. Electricity production and consumption: 2000 – 2017, Pennsylvania (trillions of BTU)



Source: Energy Information Administration

Exhibit 4-10 presents production and consumption data for electricity in millions of megawatt hours. The state has been a net exporter of at least 50 million megawatt hours of electricity since 2000.

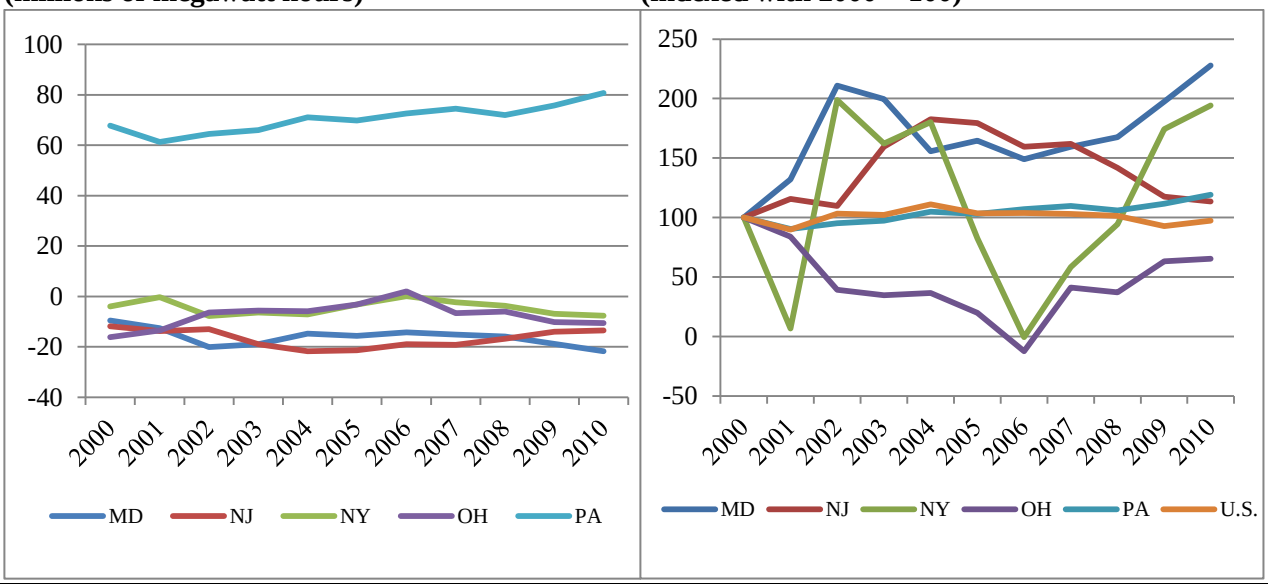
Exhibit 4-10. Electricity production and consumption in Pennsylvania: 2000 - 2017 (millions of megawatt hours)



Source: Energy Information Administration

Exhibit 4-11 compares the balance of electricity production and consumption in Pennsylvania with those of nearby states. Pennsylvania is the only state that has consistently been a major exporter of electricity.

Exhibit 4-11. Balance of electricity production and consumption, Pennsylvania and nearby states



Source: Energy Information Administration

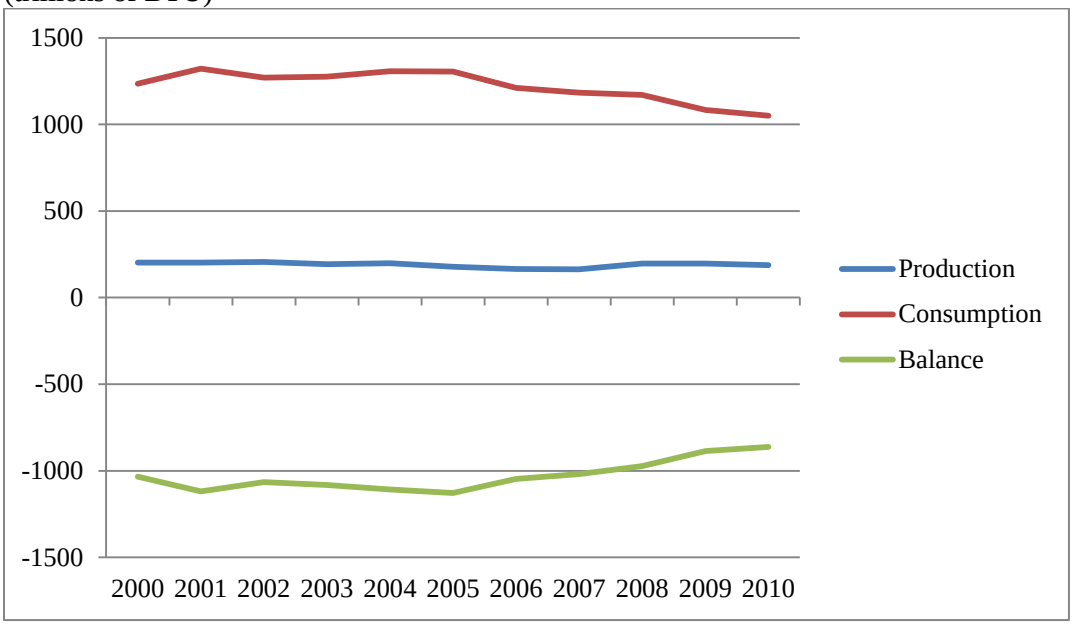
4.5 All Other Forms of Energy Production and Consumption

Natural gas, coal, and electricity constitute over 90 percent of total energy production in Pennsylvania. Pennsylvania is a significant exporter of natural gas and electricity while coal production and consumption are essentially in balance.

Remaining energy production encompasses crude oil and a variety of other forms of energy (e.g., ethanol, biodiesel, and wood). On the consumption side, petroleum products, particularly those used in the transportation sector, predominate.

As shown in Exhibit 4-12, the trend for all energy types other than coal, natural gas, and electricity from 2000 to 2010 was marked by a gradual reduction in consumption, reflecting reduced petroleum use in both commercial and residential sectors. On the other hand, production was relatively stable. As a result, the gap between other forms of energy production and consumption steadily narrowed between 2005 and 2010, when it stood at approximately 0.9 quadrillion BTU.

Exhibit 4-12. All other energy production and consumption: 2000 – 2010, Pennsylvania (trillions of BTU)



Source: Energy Information Administration

5.0 Energy Efficiency, Conservation and Innovation

Signed into law in October 2008, Act 129 expanded the responsibilities of the Pennsylvania Public Utility Commission (PUC) and added new requirements for the state's larger electric distribution companies (EDCs) in the areas of energy efficiency and conservation. With the overall goals of reducing energy consumption and demand, Act 129 required the PUC to create an overall program and to oversee work by the EDCs in areas such as smart meter technology; time-of-use rates; real-time pricing plans; default service procurement; market misconduct; alternative energy sources; and cost recovery. To achieve the goals of Act 129, EDCs have worked with various categories of customers crafting plans that meet the particular needs of these end users and the EDCs themselves.

Based on plans approved in October 2009, the initial phase of Act 129 set goals of reducing electricity usage by 3 percent and reducing peak loads by 4.5 percent by 2013. This reduction of electricity use would equal 4.4 million megawatt hours, enough electricity to serve all the needs of 419,000 average homes in Pennsylvania based on average home use in 2007.[41] Since the inception of Act 129, 3,383,465 MWh of electricity have been saved in Pennsylvania.[42]

While each EDC has its own approach and has developed plans suitable to its service territory and customers, these plans tend to focus on similar broad areas. For residential customers, plans tend to focus on:

- High-efficiency appliance incentives;
- Compact fluorescent lighting incentives;
- High-efficiency central cooling and heat pumps;
- Home audits and incentives for implementing recommendations;
- Low-income audits and appliance and air conditioning replacement;
- Time-of-use/peak pricing rates; and
- Hourly-pricing options.

For commercial, business, and industrial customers, the EDC programs address:

- Commercial HVAC high-efficiency;
- Lighting efficiency (e.g., occupancy sensors and high-intensity and LED fixtures);
- High-efficiency processes and applications;

[41] Pennsylvania Public Utility Commission. (n.d.). "Energy Efficiency & Conservation Information for Your Business" and " Energy Efficiency & Conservation Information for Your Home."
[42] Pennsylvania Public Utility Commission. Act 129 Statewide Evaluator Quarterly Report, 1st Quarter, Program Year 4.

- Direct load controls;
- Variable speed drives and applications;
- Load management services; and
- Standby generation to reduce demand during peak hours.

As the initial phase of Act 129 implementation drew to a close, the PUC commissioned a study of the impacts of the EDC programs with the goal of determining whether additional cost-beneficial efforts could be made. The results of that analysis indicated that substantial future potential exists to support a second phase of Act 129 efforts. That potential is measured in the value of lower energy usage (i.e. avoided energy costs) as a benefit and the value of efforts required to achieve those benefits (e.g., utility program costs, investments in energy efficiency and conservation) as costs. Using two scenarios, one assuming 100 percent participation, the other with more realistic assumptions, the analysis found that either scenario created more benefits than costs over 3-, 5-, and 10-year periods, as shown in Exhibit 5-1.[43]

Exhibit 5-1. Potential benefits and costs of a second phase of Act 129 programs, Pennsylvania

Time horizon	*Scenario 1. 100% participation*			*Scenario 2. Participation based on incentives 25% greater than Phase I*		
	Benefits (billions)	Costs (billions)	Ratio	Benefits (billions)	Costs (billions)	Ratio
3 years	$4.2	$2.4	1.75	$3.8	$2.2	1.73
5 years	$8.3	$4.6	1.83	$4.5	$2.5	1.85
10 years	$21.0	$10.8	1.95	$9.5	$4.8	1.97

Source: GDS Associates

In that analysis of the future potential savings from Act 129 initiatives, an assessment of a range of actions in residences was made. The potential savings from these actions was estimated to range from 4.1 percent to 5.5 percent of sales. The largest impacts were estimated to come from lighting and HVAC equipment.

[43] GDS Associates, Inc. (May 10, 2012). "Electric Energy Efficiency Potential for Pennsylvania." Pennsylvania Public Utility Commission. Available at http://www.puc.state.pa.us/electric/pdf/Act129/Act129-PA_Market_Potential_Study051012.pdf .

Exhibit 5-2. Pennsylvania residential achievable potential, 2016

End Use	*Achievable 1 Potential, Cumulative Savings, 2016*			*Achievable 2 Potential, Cumulative Savings, 2016*		
	MWh	*Percent of Total*	*MW*	*MWh*	*Percent of Total*	*MW*
Water Heating	297,078	10%	40	221,819	10%	29
Lighting	1,051,765	35%	47	798,330	36%	36
Appliances	361,681	12%	96	277,387	12%	72
Electronics	156,452	5%	26	89,391	4%	15
Pools	26,741	1%	14	20,870	1%	11
HVAC (Envelope)	376,762	13%	25	294,054	13%	20
HVAC (Equipment)	565,300	19%	295	430,188	19%	219
Whole House	139,976	5%	85	78,659	4%	48
New Construction	21,597	1%	2	16,370	1%	2
Total	***2,997,353***	***100%***	***631***	***2,227,067***	***100%***	***452***
Percent of sales	5.5%			4.1%		

Source: GDS Associates

A similar assessment of non-residential savings estimated that industrial and commercial customers of the larger EDCs could achieve savings of 1.9 percent to 3.6 percent of sales. Lighting, motors, and HVAC constituted over 75 percent of these achievable savings.[44]

Given the analysis conducted of the future potential savings achievable in a second phase, the PUC determined targets for each of the EDCs. These targets, listed in Exhibit 5-3 range from 1.6 percent or 2.9 percent of 2009/10 forecast.[45]

Exhibit 5-3. Act 129 Phase II 3-year energy efficiency reduction compliance targets

EDC	*3-year program acquisition cost (S/MWh)*	*3-year share of 2009/10 forecast reductions*	*3-year MWh value of 2009/10 forecast reductions*
Duquesne	$211.90	2.0	276,722
Met-Ed	$220.87	2.3	337,753
Penelec	$216.19	2.2	318,813
Penn Power	$209.20	2.0	95,502
PPL	$224.71	2.1	821,072
PECO	$227.55	2.9	1,125,851
West Penn	$209.42	1.6	337,533

Source: Pennsylvania Public Utility Commission

[44] Ibid.
[45] Pennsylvania Public Utility Commission. (August 2, 2012). "Implementation order."

The various efforts generated by Act 129 are among many that states and utilities have implemented to engender more efficient and effective use of energy. Exhibit 5-4 summarizes recent financial data and some impact data for energy efficiency programs in Pennsylvania and nearby states as summarized in the 2012 State Energy Efficiency Scorecard.

For electrical programs, Pennsylvania lagged behind many nearby states in terms of the percentage of statewide utility revenue spending directed toward electrical programs, although at 1.44 percent of statewide utility revenues, spending was well above the national median and close to the national average of 0.96 percent. On the basis of dollars spent per residential customer, natural gas programs in Pennsylvania also spent less than their counterparts in many nearby states (approximately $8 compared to $40 in New Jersey, $28 in New York, and $13 in Ohio). These expenditures were above the national median of $7.36, but well below the national average of $17.40 for natural gas energy efficiency programs. In the aggregate, estimated 2010 electricity savings in Pennsylvania were similar to those in Maryland and New Jersey, but well below savings in New York and Ohio. As a share of statewide retail sales of electricity, the savings impact in Pennsylvania (0.23 percent) was less than that of any of the nearby states shown in Exhibit 5-4 and well below the national average and the national median, 0.49 percent and 0.38 percent respectively.

Exhibit 5-4. Budgets and impacts for energy efficiency programs – 2011

	Budgets, electrical programs (millions)	*Share of statewide utility revenues*	*Budgets, natural gas programs (millions)*	*Dollars spent per residential customer*	*2010 net incremental electricity savings (MWh)*	*Share of statewide electricity savings as a % of electricity retail sales*
Maryland	$156.4	2.05%	$4.6	$4.29	330,678	0.48%
New Jersey	$225.0	2.05%	$106.0	$40.03	313,116	0.40%
New York	$1,073.2	4.69%	$119.4	$27.55	1,215,844	0.84%
Ohio	$134.4	0.96%	$42.6	$13.14	722,929	0.47%
Pennsylvania	$225.0	1.44%	$21.6	$8.18	344,256	0.23%
U.S. total/average	$5,916.8	1.60%	$1,138.2	$17.40	18,436,366	0.49%
U.S. median	$40.7	0.96%	$4.6	$7.36	142,860	0.38%

Source: 2012 State Energy Efficiency Scorecard

Finally, other organizations have noted the potential and existing economic benefits of pursuing energy efficiency in Pennsylvania. For example, according to the Brookings Institute, in 2010 Pennsylvania had 42,548 employees in jobs related to energy and

resource efficiency, ranking fifth highest in the country.[46] In addition, Optimal Energy estimates that energy efficiency achieved by Act 129 will create over 1,600 new jobs by mid-2013.[47]

5.1 Distributed and Dispersed Generation Technologies and Initiatives

A wide variety of technologies and other opportunities can be used to promote the efficient use of energy and conservation. These opportunities can be categorized in two major ways, distributed and dispersed generation.

Distributed Generation

- Net metering

Distributed generation is a process where entities generate electrical power for on-site use. They also have the ability to deliver power to the electrical grid for localized distribution of energy to large numbers of commercial, industrial, and residential customers.

Distributed generation technologies are metered. Net meters are able to measure energy that is delivered to the end user and, more importantly, measure energy that the end user sells back to the utilities.[48] The majority of net meters connect residential users to the grid. These users are credited on the power they generate but do not use. During a set period of time if more power is generated than is used the excess power is then sold to the distribution company. The distribution company therefore pays the power generator for the full cost of the power.

As noted in Exhibit 5-5, there are approximately 8,024 net meters in place in Pennsylvania. These have an installed capacity of 184.7 megawatts. In total, these end users sold 6,742.5 megawatt hours of electricity to electrical distributors in 2011. Solar photovoltaic systems, primarily those of residential customers, generated more than 95 percent of the capacity and 99 percent of the energy sold.

[46] Muro, Mark and Jonathan Rothwell. "Sizing the Clean Economy," The Brookings Institute. 2010.
[47] Optimal Energy, Inc. (December 19, 2011). *Pennsylvania 2013 – 2018 Energy Efficiency Goals.* PennFuture.
[48] The AEPS Act defines net metering as "[t]he means of measuring the difference between the electricity supplied by an electric utility and the electricity generated by a customer-generator when any portion of the electricity generated by the alternative energy generating system is used to offset part or all of the customer-generator's requirements for electricity." 73 P. S. § 1648.2.

Exhibit 5-5. Net meters in Pennsylvania

Fuel type and sector	*Net metering customers*	*Installed capacity (megawatts)*	*Energy sold to utilities (megawatt hours)*
Photovoltaic (solar)	7,766	175.9	6,704.6
Wind	224	1.0	1.4
All Other	34	7.8	36.5
Total	**8,024**	**184.7**	**6,742.5**

Sources:
Pennsylvania Department of Environmental Protection, Revised 2013
Energy Information Administration, Pennsylvania Public Utility Commission

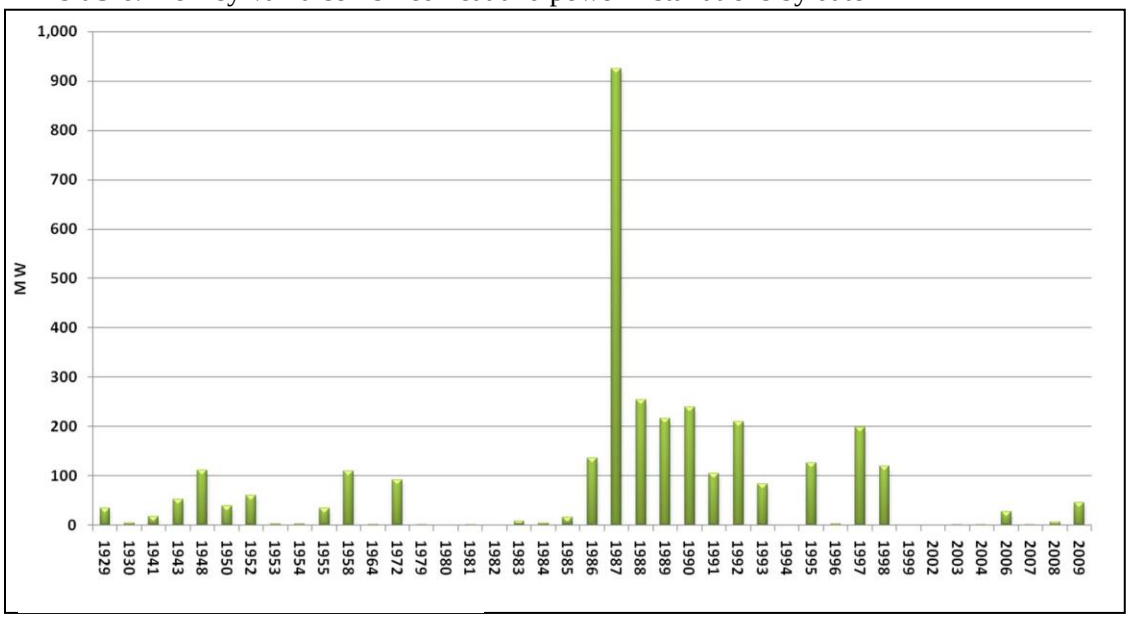
- Combined Heat and Power

Combined heat and power generation facilities take advantage of the fact that the generation of electricity creates an enormous amount of heat that can represent an important input to certain economic activities. Combined heat and power generation and consumption can substantially increase the percentage of input energy that is productively utilized.

Exhibit 5-6 conveys a history of combined heat and power installations, and site locations by fuel source in Pennsylvania. The graph indicates combined heat and power was a focus of investment in the Commonwealth from the mid-1980's to the late-1990's. Installations dropped dramatically thereafter because of financial instability in the market place, growing volatility of natural gas prices, and regulatory uncertainty.[49]

[49] Penn State University. "Pennsylvania Combined Heat and Power Baseline Assessment." June 30, 2011.

Exhibit 5-6. Pennsylvania combined heat and power installations by date



Fuel Type	*Pennsylvania*	
	Sites	Capacity (MW)
Biomass	23	81
Coal	24	1,113
Natural Gas	54	1,475
Oil	7	18
Waste	22	555
Wood	2	31
Other	3	5
Total	**135**	**3,276**

Graph Source: Commonwealth Recycled Energy Economic Development Alliance Table Source: ICF International. (2011). http://www.eea-inc.com/chpdata/index.html

Dispersed Generation

Dispersed generation is a second major technology that has been developed to advance energy efficiency and conservation. It relies almost without exception on internal combustion and reciprocating engines. It is also considered a form of backup power, be it in the form of natural gas, propane, diesel, and gasoline. It is not a grid-connected source of energy.

A survey published in 2012 of small (i.e. less than 1 megawatt capacity) dispersed generation facilities estimated that 270 such facilities exist in Pennsylvania and have a

total generating capacity of almost 105 megawatts.[50] Over 99 percent of this capacity is used only for emergency backup service and essentially all of this generation is provided by internal combustion/reciprocating engines. These dispersed generation facilities are not connected to the electrical grid. Their critical function is to provide continuity of service when there are power outages on the grid. This capacity to maintain service for businesses, institutions, and other entities can provide economic and other benefits not only to those directly connected to this dispersed generation, but also to the communities served by these businesses and institutions.

5.2 Metering and Competitive Generation Supply

Advanced Meters

More sophisticated management of electricity use depends significantly on more precise and more readily available information regarding electricity utilization. Electrical meters that can communicate with EDCs and/or end users are a critical link in the chain of information that informs more intelligent energy use. Advanced metering technology allows for a less arbitrary approach on the part of energy distributors to predict on- and off-peak periods of energy usage and when to shift loads. The technology offers a more scientific way to manage energy distribution and transmission for both the grid and its customers.

Two types of metering technology and associated equipment are part of the evolution in electricity management. Automated meter reading (AMR) refers to meters that collect data for billing purposes only and transmit these data one way, usually from the customer to the distribution utility. Typically these data are aggregated and communicated on a monthly basis. Aggregated data captured on these meters may be retrieved by a variety of methods, including through the use of drive-by vehicles with special remote reading and communication capabilities to a remote location over a fixed network such as a cellular network. The AMR system promotes conservation by allowing energy consumers who have installed meters to track their consumption on a daily, weekly, monthly, and yearly basis alongside their energy charges. As the systems are electronically based, customers are able to track this information from home or wirelessly. The added transparency AMRs offer promotes more economically-minded consumer behavior.

[50] Data are from the Annual Survey form EIA-861 -- Annual Electric Power Industry Report, U.S. Department of Energy, November 27, 2012. Data for Pennsylvania are reported from a subset of all the state's electric distribution companies.

Advanced metering infrastructure (AMI) is a more sophisticated metering system. With AMI, meters measure and record usage data at hourly or at more frequent intervals. These usage data are then provided to both end users and energy companies at least daily. These data are used for billing and other purposes such as energy management or time-of-day billing rates. Advanced meters include basic hourly interval meters and can extend to real-time meters with built-in two-way communication capable of recording and transmitting instantaneous data.[51] As with AMRs, the primary objective of AMI is to enable retail customers to achieve cost savings through energy efficiency and conservation. A 2007 report issued by the PUC noted that sound implementation of AMI would result in better control of peak loads and improved overall grid reliability.[52]

Exhibit 5-7 provides information regarding the distribution of AMR and AMI meters in the state. As shown, the total number of AMR devices increased 55 percent from 2007 to 2011 when almost 2.4 million AMR devices were in place. Residential meters comprise 90 percent of total meters statewide.

Growth in AMI systems was less robust, but still experienced an increase in installed systems of 14 percent from 2007 to 2011. By 2011, substantially more AMR meters were in place compared to installed AMI meters (2.4 million versus 1.6 million).

In 2011, a total over 39 million megawatt hours of electricity were served through AMI systems. Roughly 40 percent of this power was delivered to residential customers. A similar, though somewhat smaller share, went to commercial customers, while industrial customers accounted for almost all remaining energy delivered through AMI systems. With either type of advanced meter the transportation sector represented an insignificant share of overall installations or other activity. Installed AMI systems accounted for 40 percent of all electricity delivered to residential users in Pennsylvania in 2011.

[51] Definitions of AMR and AMI are from the U.S. Department of Energy, Energy Information Administration, Form EIA-861, Annual Electric Power Industry Report. This form is used to gather data from the nation's electricity companies.
[52] Pennsylvania Public Utility Commission. "Report on Conservation, Energy Efficiency, Demand Side Response and Advanced Metering Infrastructure." June 6, 2007.

Exhibit 5-7. Meter distribution in Pennsylvania: 2007 and 2011

Type of meter/volume of electricity metered	*2007*	*2011*	*2011 % of total*	*2011/2007 % Change*
No. of AMR meters, residential	1,396,097	2,111,101	89.5%	51%
No. of AMR meters, commercial	128,444	238,676	10.1%	86%
No. of AMR meters, industrial	1,999	8,890	0.4%	345%
No. of AMR meters, transportation	-	68	0.0%	N.A.
Total No. of AMR meters	*1,526,540*	*2,358,735*		*55%*
No. of AMI meters, residential	1,203,471	1,374,242	88.0%	14%
No. of AMI meters, commercial	168,225	183,447	11.7%	9%
No. of AMI meters, industrial	4,565	4,474	0.3%	-2%
No. of AMI meters, transportation	-	1	0.0%	N.A.
Total no. of AMI meters	*1,376,261*	*1,562,164*		*14%*
Energy served thru residential AMI meters (megawatt hours)	14,403,952	15,916,607	40.7%	11%
Energy served thru commercial AMI meters (megawatt hours)	13,886,915	14,536,148	37.2%	5%
Energy served thru industrial AMI meters (megawatt hours)	9,617,876	8,578,679	21.9%	-11%
Energy served thru transportation AMI meters (megawatt hours)	-	95,361	0.2%	N.A.
Total energy served thru AMI meters (megawatt hours)	*37,908,743*	*39,126,795*		*3%*

Source: Energy Information Administration[53]

Pennsylvania has been a leader in its region in the installation and use of these advanced meters. As shown in Exhibit 5-8, New York has a similar absolute number of AMR meters, but has relatively few AMI meters in place. Other nearby states have been even less successful in having these types of advanced meters in place. Among these states, Ohio has the second highest total of AMI meters, but has about one-third of the number in place as Pennsylvania. In 2011, the volume of energy served through AMI meters in Pennsylvania was about four times the volume served in New York. Volumes through AMI meters in other nearby states were much lower.

[53] Information is obtained from EIA's Form 861, which is completed by electric power industry entities, including: electric utilities; all DSM Program Managers (entities responsible for conducting or administering a DSM program); wholesale power marketers (registered with the Federal Energy Regulatory Commission); energy service providers(registered with the States); and electric power producers. Responses are collected at the business level, not at the holding company level.

Exhibit 5-8. Advanced meters in Pennsylvania and nearby states: 2007 and 2011

Type of meter/volume of electricity metered	*2007*	*2011*	*Change*
• Pennsylvania			
Total No. of AMR meters	1,526,540	2,358,735	55%
Total no. of AMI meters	1,376,261	1,562,164	14%
Total energy served thru AMI meters (megawatt hours)	37,908,743	39,126,795	3%
• Maryland			
Total No. of AMR meters	725,634	902,933	24%
Total no. of AMI meters	0	912	N.A.
Total energy served thru AMI meters (megawatt hours)	0	1,110	N.A.
• New Jersey			
Total No. of AMR meters	8,132	35,412	335%
Total no. of AMI meters	0	11,610	N.A.
Total energy served thru AMI meters (megawatt hours)	0	149,705	N.A.
• New York			
Total No. of AMR meters	1,534,285	2,328,801	52%
Total no. of AMI meters	1,553	18,785	1110%
Total energy served thru AMI meters (megawatt hours)	12,550	10,461,924	83262%
• Ohio			
Total No. of AMR meters	277,489	727,112	162%
Total no. of AMI meters	16,631	506,635	2946%
Total energy served thru AMI meters (megawatt hours)	255,852	3,711,795	1351%

Source: Energy Information Administration

Smart Grids

Smart grids are a 21st century response to the need for better management of the transmission and distribution of electrical power. Central characteristics of smart grids include the availability of real-time information on energy use and multipath communication of this information among suppliers, distributors, and users. A key component of smart grids is smart meters (the Advanced Metering Infrastructure, AMI, discussed above). Pennsylvania has been in the forefront of policies and actions promoting the installation of AMI devices and other elements of this technology (e.g., net metering and distributed generation).

Renewable and Alternative Energy Supply Option Programs

In the deregulated world of electricity, customers may choose among suppliers including those with power generated from renewable resources. This option allows customers to support the development and implementation of renewable and alternative projects.

Exhibit 5-9 provides data regarding these customers and the value and volume of those purchases. Almost all renewable and alternative energy customers are residential customers. From 2007 to 2011, there was a modest decline in the total number of green energy customers, reflecting a drop in the number of residential customers. There was an

even larger decline in the value of renewable and alternative energy sales from 2007 to 2011. On the other hand, the total volume of renewable and alternative energy sold in 2011 was 60 percent higher than the volume sold in 2007. In that four-year period, commercial purchases of renewable and alternative energy increased 657 percent, growing from 6 percent to 27 percent of the total. These countervailing trends of declining total sales and rising volumes reflect the fact that average renewable and alternative energy prices fell by about half from 2007 to 2011.

Exhibit 5-9. Renewable and alternative energy supply programs in Pennsylvania

	2007	*2011*	*Change*
Number of residential consumers	38,301	35,477	-7.4%
Number of commercial consumers	768	2,110	174.7%
Number of industrial consumers	30	34	13.3%
Total number of consumers	39,099	37,621	-3.8%
Revenue, residential customers (millions)	$4.7	$2.9	-39.6%
Revenue, commercial customers (millions)	$0.6	$1.6	167.7%
Revenue, industrial customers (millions)	$0.5	$0.2	-54.4%
Total revenue, green pricing programs (millions of dollars)	$5.8	$4.7	-19.3%
Electricity sales, residential customers (megawatt hours)	132,801	184,020	38.6%
Electricity sales, commercial customers (megawatt hours)	9,623	72,887	657.4%
Electricity sales, industrial customers (megawatt hours)	25,414	12,206	-52.0%
Electricity sales, all customers (megawatt hours)	167,838	269,114	60.3%

Source: Energy Information Administration

6.0 Energy and Energy-related Infrastructure and Industry

Energy production places demands on infrastructure which can be a help or hindrance to the more effective and efficient use of that energy. The abundance of energy resources also creates opportunities for economic development either in providing the infrastructure required for expanded production or in industries which are particularly reliant on energy as an input to production.

6.1 The Electricity Market in Pennsylvania

Pennsylvania was a pioneer in deregulating the electricity market with the passage of its first deregulatory legislation in December 1996.[54] The deregulatory process a decoupled power generation from transmission and distribution. Consequently Pennsylvanians can choose among various electricity providers (i.e. generators) which use EDCs to deliver that electricity to customers.

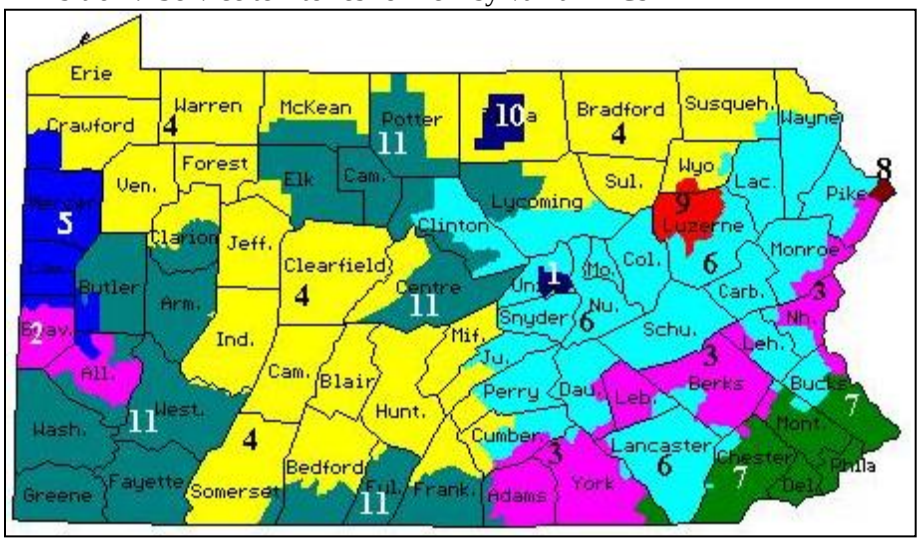
Eleven EDCs currently serve most of the state's customers. The 11 major EDCs are listed below.[55]

1. Citizens' Electric Company
2. Duquesne Light Company
3. Metropolitan Edison Company (FirstEnergy)
4. Pennsylvania Electric Company (FirstEnergy)
5. Pennsylvania Power Company (FirstEnergy)
6. PPL Electric Utilities Corporation
7. PECO Energy Company (Exelon)
8. Pike County Light & Power Company (Orange & Rockland Utilities Inc.)
9. UGI Utilities Inc. – Electric Division
10. Wellsboro Electric Company
11. West Penn Power Company (FirstEnergy)

Exhibit 6-1 indicates the service territories of the state's 11 EDCs. Service territories are keyed to the list above. That is, the number on the map corresponds to the number on the list above.

[54] "Pennsylvania Electricity Deregulation," electricchoice.com http://www.electricchoice.com/PA
[55] "Electric Power Outlook for Pennsylvania: 2010-2015," Pennsylvania Public Utility Commission, July 2011 http://www.puc.pa.gov/general/publications_reports/pdf/EPO_2011.pdf

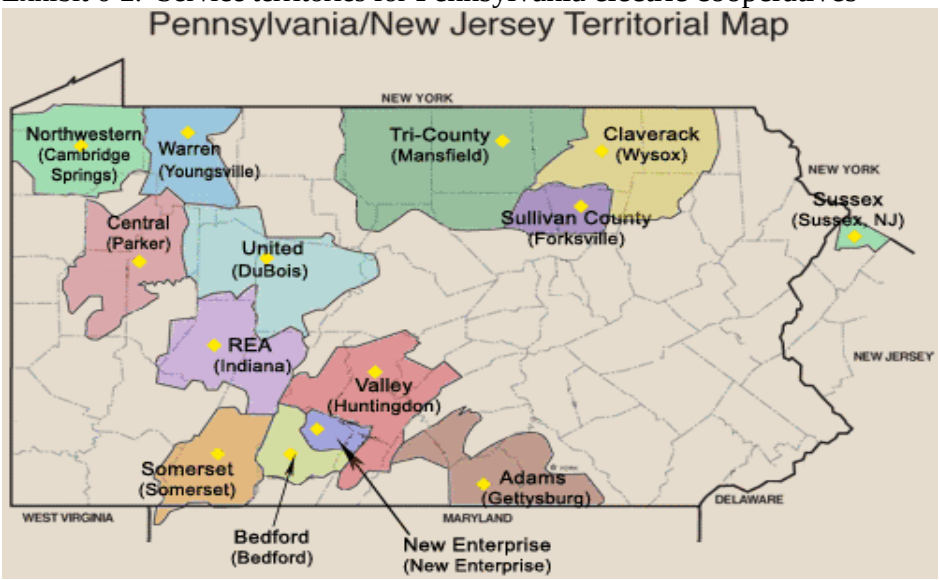
Exhibit 6-1. Service territories for Pennsylvania EDCs



Source: Pennsylvania Public Utility Commission

While the 11 EDCs serve the great majority of the state's customers, about 600,000, mostly rural customers are served by electric cooperatives. The service territories of these cooperatives are shown in Exhibit 6-2.

Exhibit 6-2. Service territories for Pennsylvania electric cooperatives



Source: Electricchoice.com

6.2 Current Infrastructure Status

Electrical Grid

The entire electricity generation, transmission, and distribution system in the United States is highly interconnected and overseen by a hierarchy of organizations charged with managing and optimizing the reliable delivery of electrical power to end users. Electric Distribution Companies (EDCs) in Pennsylvania are interconnected with neighboring systems that extend beyond the boundary of the state. Systems are organized into regional entities responsible for securing the reliability of the bulk electric power system.

Pennsylvania is within the bounds of the Reliability*First* Corporation (RFC), a regional reliability entity overseeing all of Pennsylvania, New Jersey, Delaware, Maryland, the District of Columbia, West Virginia, Ohio, Indiana, Lower Michigan and portions of Upper Michigan, Wisconsin, Illinois, Kentucky, Tennessee and Virginia.[56]

Within the Reliability*First* Corporation area are two regional transmission reliability companies that coordinate the operation of generating capacity and transmission lines. One of these is the PJM Interconnection that covers a multistate area stretching from northeastern North Carolina to northeastern Indiana and includes 214,000 square miles. Within this area PJM coordinates the operation of 185,600 MW of generating capacity and 65,000 miles of transmission lines. Pennsylvania lies wholly within the PJM Interconnection territory.

Another organizational structure relevant to Pennsylvania's electrical infrastructure in the Mid-Atlantic Area National Interest Electric Transmission Corridor (NIETC). NIETC includes 52 of Pennsylvania's 67 counties. One focus of the NIETC designation is congestion. Every three years, the U.S. Department of Energy conducts a study of congestion in designated corridors to determine the extent to which transmission is constrained and the factors leading to any such constraints. The latter include equipment, operational limits, and lack of transmission capacity within the limits required to preserve reliability.

Appropriate responses to congestion include:

- Reducing demand through energy efficiency and demand management programs;
- Expanding generation capacity close to the area of demand;
- Increasing distributed generation consistent with land use practices; and

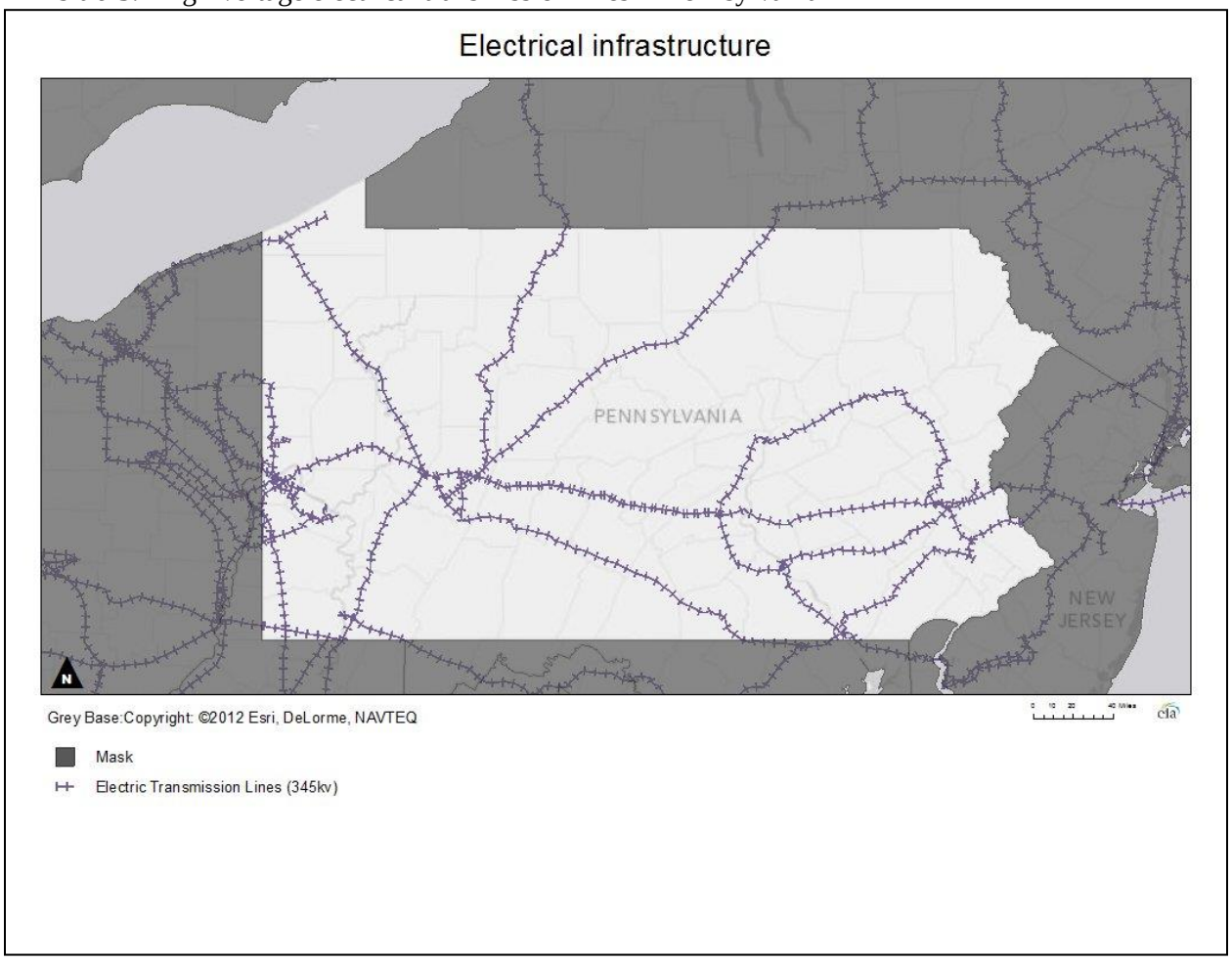
[56] Pennsylvania Public Utility Commission. (August 2012). "Electric Power Outlook for Pennsylvania 2011–16."

- Expanding transmission capacity to enable the delivery of electricity from more distant sources.

Recent congestion studies have identified congestion problems that involved the transmission system in Pennsylvania. The majority of these problems were not confined to Pennsylvania, but rather involved the flow of power across the state to external centers of power demand such as the New York and Baltimore-Washington, DC regions.[57]

The interstate nature of these problems is simply a reflection of the interconnected, interdependent nature of electrical power. A sense of that interconnectedness can be seen in the map of high-voltage power lines in Pennsylvania, shown in Exhibit 6-3. These transmission lines ignore state boundaries in their service of a regional electrical grid.

Exhibit 6-3. High-voltage electrical transmission lines in Pennsylvania



Source: Energy Information Administration

[57] Ibid.

Based on the most recent congestion studies, two projects within the PJM territory have had or will have an impact on the transmission infrastructure in Pennsylvania:

- TrAIL, a 500 kilovolt transmission line, was placed in service in May 2011. By connecting substations in southwestern Pennsylvania with others in West Virginia and northern Virginia, service reliability was improved in the Washington, DC, northern Virginia, and Baltimore areas; and
- Susquehanna-Roseland, another 500 kilovolt line, is proposed to reduce congestion in eastern Pennsylvania and northern New Jersey and is expected to be in service by June 2015.

Pipelines

Because of its history as an oil and gas producer, Pennsylvania has a significant network of large interstate and intrastate pipelines. As of the end of 2008, there were almost 8,700 miles of such pipelines in place. Additions and expansions that have been completed or were under construction and expected to be in service by the close of 2012 will add almost 500 miles to this network as noted in Exhibit 6-4. An additional 136 miles of pipeline have been approved but construction was not expected to be completed until 2013. Applications for 44 miles of pipeline had been submitted. Finally, projects totaling 572 miles with expected in service dates ranging from 2013 to 2015 had been announced. Data on individual projects is included at the end of Appendix 6.[58]

Exhibit 6-4. Miles of large interstate/intrastate pipeline, Pennsylvania

	2008	2009	2010	2011	2012
Additions		14	32	199	232
Total miles	8,680	8,694	8,726	8,926	9,158

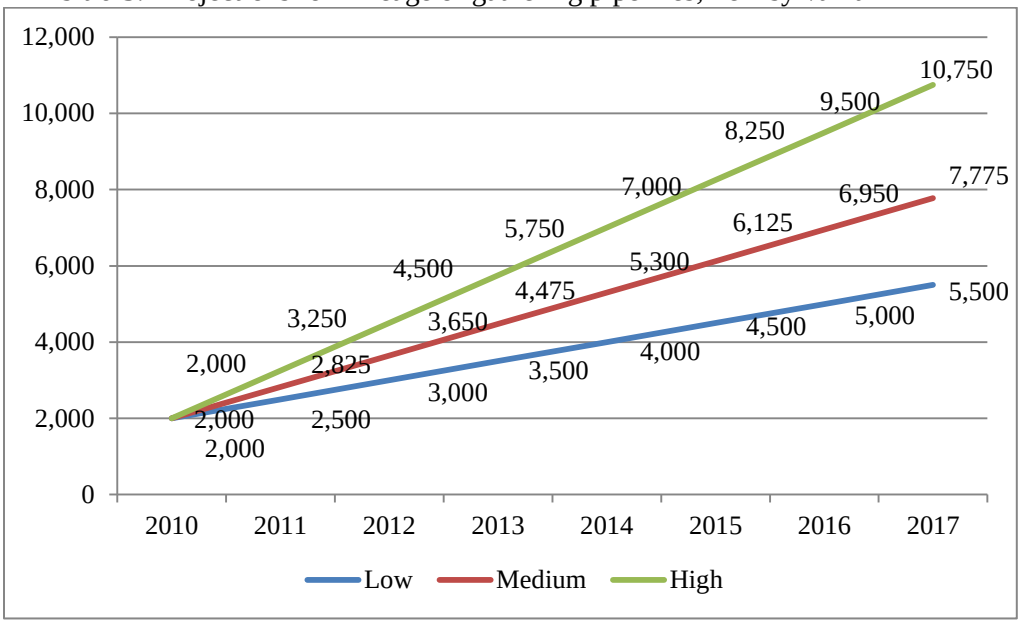
Source: Federal Energy Regulatory Commission, Energy Information Administration

The more dynamic activity in the Pennsylvania pipeline infrastructure is likely to be in the development of new gathering pipelines to connect drilling sites with the larger network of interstate/intrastate pipelines. A recent study by the Nature Conservancy estimated 1.65 miles of these gathering pipelines were required for each new drilling site. Based on a range of possible new drilling sites in Pennsylvania, this analysis estimated that anywhere from 500 to 1,250 miles of gathering pipeline would be needed on average over the 20-year period from 2010 to 2030. Using these annual average additions to the network of gathering pipelines, Exhibit 6-5 projects the total mileage of this part of the pipeline infrastructure from 2010 when an estimated 2,000 miles existed to 2017. At the

[58] U.S. Energy Information Administration, Gas Transportation Information System, Pipeline Map Files and Pipeline Projects Database.

end of that period, total gathering pipeline mileage would range from 5,500 miles to 10,750 miles depending on the rate at which new drilling sites are developed. The midrange estimate is 7,775 miles of gathering pipeline. This rate of construction is considerably higher than the recent experience with larger diameter pipelines.

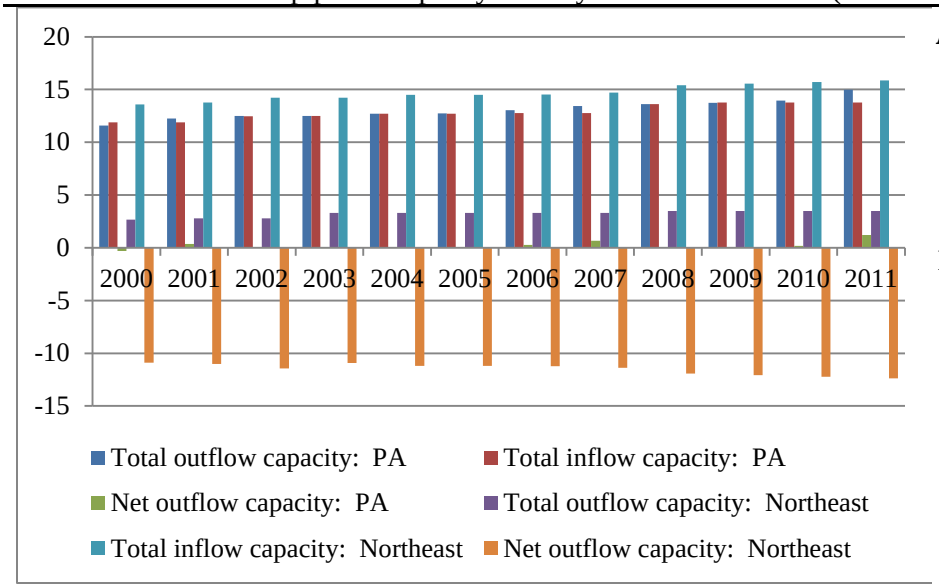
Exhibit 6-5. Projections for mileage of gathering pipelines, Pennsylvania



Source: The Nature Conservancy

The impact of Marcellus Shale on pipeline infrastructure can be seen in the trends for pipeline capacity and the direction that natural gas is moving. Exhibit 6-6 tracks changes in capacity and the flow of natural gas in and out of Pennsylvania and the Northeast region. Since 2000, those flows in Pennsylvania have reversed from an inflow of 0.3 billion cubic feet per day (bcfd) to an outflow in 2011 estimated at 1.3 bcfd. That is, the state has become an exporter of natural gas. Over that same period the Northeast region has increased the inflow of natural gas from 10.9 bcfd to 12.4 bcfd. See Exhibit 6-6.

Exhibit 6-6. Trends in pipeline capacity: Pennsylvania vs. Northeast (billions of cubic feet/day)



Average annual growth rate	
Outflow: PA	2.4%
Inflow: PA	1.3%
Outflow: Northeast	2.4%
Inflow: Northeast	1.4%

Source: Energy Information Administration

Pennsylvania's pipeline infrastructure is expected to increase capacity significantly in the near future. As of 2011 Pennsylvania pipeline capacity was 15 bcfd outflow and 13.8 bcfd inflow. Between 2012 and 2015, pipeline projects that are completed, under construction, or approved will add 5.4 bcfd to that capacity. Another 5.8 bcfd of capacity are in projects that have applied for approval, have completed some preliminary application steps, or have been announced. Regardless of the final disposition of projects that have not yet been approved, total capacity of the state's pipeline infrastructure will increase substantially. These projects include those entirely in the state as well as others located in Pennsylvania and other states. See Exhibit 6-7.

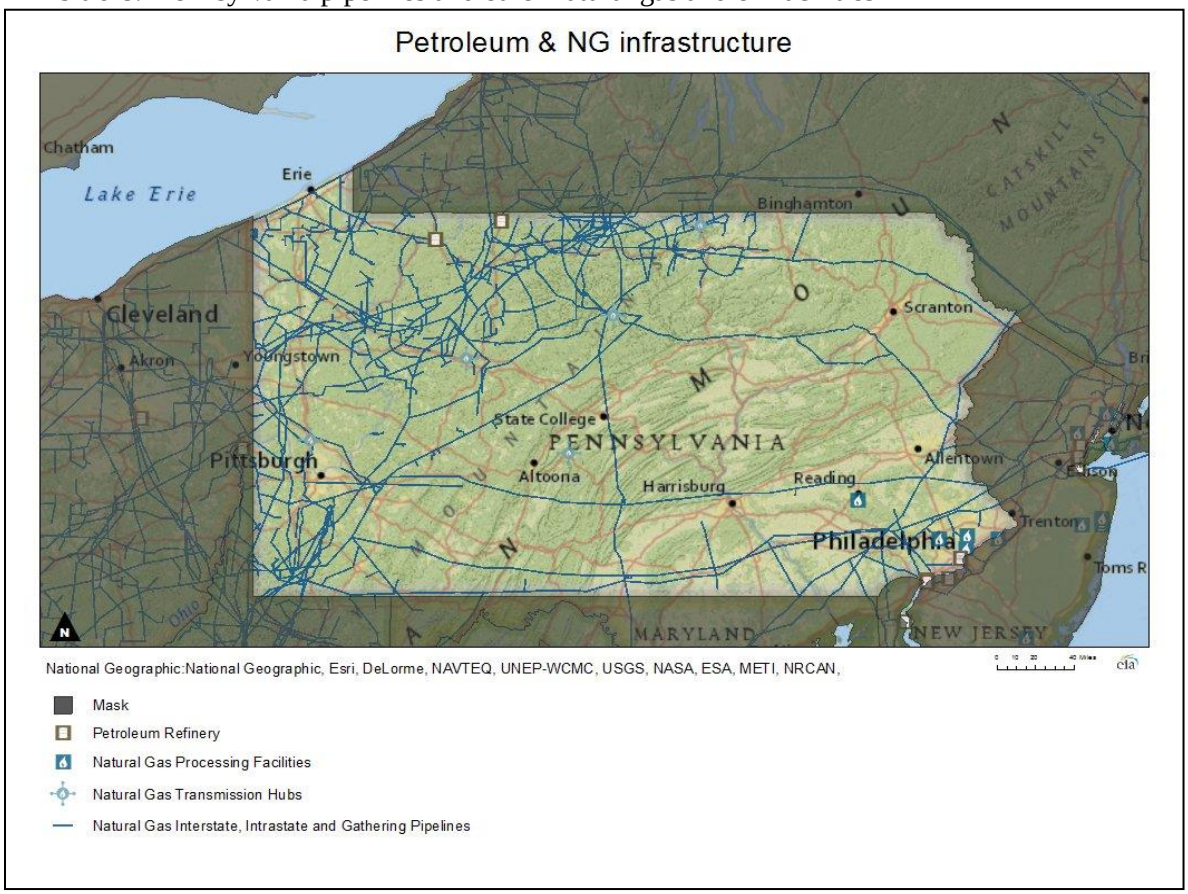
Exhibit 6-7. Interstate pipeline projects 2012 - 2015

Status	*No of projects*	*Added capacity (Bcfd)*	*PA only projects*	*Multistate projects*	*Other states*
Completed	1	0.3	0	1	WV
Construction	10	2.7	6	4	NY,WV
Approved	3	2.4	1	2	MD,NJ
Applied	4	0.9	3	1	NJ,NY
Pre-applied	1	1.4	1	0	
Announced	10	3.5	5	5	MD,NY,CT,RI,MA

Source: Energy Information Administration

A visual guide to this petroleum and natural gas infrastructure is presented in Exhibit 6-8. This includes all levels of pipelines as well as refineries and gas processing facilities.

Exhibit 6-8. Pennsylvania pipelines and other natural gas and oil facilities



Source: Energy Information Administration

Transit

Public transit systems--both rail and non-rail--provide an energy efficient alternative to private vehicles. This public infrastructure has been growing modestly since 2000 in terms of directional route miles (i.e. fixed guideways for rail systems and mixed traffic for non-rail systems). Average fleet of vehicles and the maximum number of vehicles placed in service have remained essentially unchanged since 2000.

The use of public transit systems in Pennsylvania has grown relatively steadily particularly in more recent years. Similarly the total number of passenger miles has grown at a modest average pace and more consistently since 2006. Year-to-year statistics on public transit are presented in Exhibit 6-9 which summarizes data for all Pennsylvania-based public transit systems.

Exhibit 6-9. Public transit trends in Pennsylvania: 2000 to 2011

	Directional route miles	*Vehicles operated in maximum service*	*Average fleet size*	*Unlinked passenger trips (millions)*	*Passenger miles traveled (millions)*
2000	11,131	4,698	5,741	428	1,934
2001	11,414	4,675	5,777	428	1,921
2002	11,268	4,533	5,807	422	1,886
2003	11,489	4,657	5,899	424	1,921
2004	11,228	4,807	5,629	433	1,973
2005	11,408	4,807	5,720	437	2,019
2006	11,925	4,649	5,656	429	1,987
2007	12,343	4,689	5,609	428	2,041
2008	12,364	4,627	5,610	445	2,128
2009	12,351	4,759	5,776	454	2,150
2010	13,208	4,821	5,854	450	2,151
2011	12,836	4,668	5,853	462	2,255
Average growth rate	**1.3%**	**-0.1%**	**0.2%**	**0.7%**	**1.4%**

Source: National Transit Database

6.3 Energy-Related and Energy-Intensive Industry

The energy boom in natural gas that has spread across Pennsylvania creates economic activity in the various stages of finding and extracting natural gas from underground deposits. The economic dimensions of these extractive activities were discussed in Section 3 above.

The need to gather, transport, and distribute product through pipelines has created demands for construction activities that are only likely to grow as the volume of gas produced in the state increases. Between 2003 and 2010, construction employment related to oil and gas pipelines and related structures almost doubled, increasing from just under 1,400 workers to over 2,500 workers. In that same period, employment in the construction of power and communications lines and related structure increased by over one-third from over 9,700 to an estimated 13,300. Year- by-year employment data are provided in Exhibit 6-10.

Because of issues stemming from the non-disclosure of data, only about one quarter of this statewide employment can be assigned to specific counties. The data manage to indicate that Montgomery County is home to a substantial number of these construction workers. However, overall reporting at the local level is spotty at the 5-digit NAICS code level.

Exhibit 6-10. Employment in energy infrastructure-related construction in Pennsylvania

Construction sector	2003	2004	2005	2006	2007	2008	2009	2010
Oil and gas pipeline and related structures	1,397	1,614	1,025	922	922	2,206	2,463	2,566
Power and communication line and related structures	9,737	18,659	9,613	10,458	11,722	13,026	13,540	13,300
Notes. Oil/gas pipeline construction is NAICS 23712. Power/communication lines construction is NAICS 23713.								

Source: U.S. Census Bureau

One perspective on the distribution of business activity related to oil and gas and electricity infrastructure within Pennsylvania is provided in Exhibit 6-11. Business establishments providing the employment shown in Exhibit 6-11 are listed by county.

Exhibit 6-11. Oil and gas pipeline-related and power and communication line-related business establishments in Pennsylvania by county

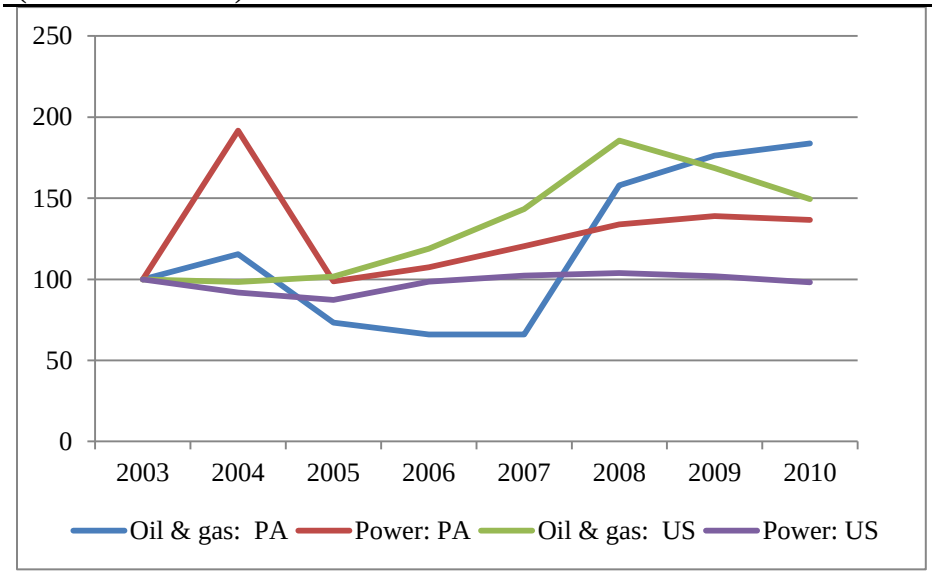
County	Oil and gas pipeline construction			Power and communication lines construction		
	2001	2005	2011	2001	2005	2011
Adams		1	1		1	1
Allegheny	9	9	5	16	17	18
Armstrong		2	3			
Beaver					2	4
Bedford					5	
Berks		3	1	5	5	6
Blair		1	1	7	9	7
Bradford			3		2	1
Bucks		3	5		16	18
Butler		1	1		2	6
Cambria					3	3
Carbon					2	1
Centre			1		1	1
Chester		1	2		5	11
Clarion					1	1
Clinton			1		1	1
Columbia					3	1
Crawford		2	4			
Cumberland					1	3
Dauphin					7	7
Delaware		1	2		7	8
Elk						
Erie	3	2		3	1	3
Fayette			1		2	1
Franklin					1	2

County	Oil and gas pipeline construction			Power and communication lines construction		
	2001	2005	2011	2001	2005	2011
Fulton					2	1
Greene		1	4			1
Huntingdon					3	3
Indiana		2	5		1	3
Jefferson		2	3		1	
Juniata						
Lackawanna					4	3
Lancaster					6	5
Lawrence				5	3	2
Lebanon		1			2	5
Lehigh			1		9	8
Luzerne					5	7
Lycoming			3		3	3
McKean		2	1			
Mercer						
Mifflin						
Monroe					2	2
Montgomery		5	3		13	22
Montour					3	2
Northampton			1		2	5
Northumberland			1		3	3
Perry					1	1
Philadelphia		2			2	6
Pike					2	1
Potter		2	1			
Schuylkill		1	1		3	3
Somerset					3	1
Susquehanna		1	1		1	1
Tioga			2			
Venango					1	2
Washington		1	7		5	4
Wayne					2	3
Westmoreland	6	2	2	10	10	7
Wyoming			1		1	2
York			1		4	5
Unknown/Unidentified	15	16	48	26	35	62
Statewide	73	63	116	202	224	272

Source: Bureau of Labor Statistics

Compared to the nation, growth in employment in these construction industries grew much faster in Pennsylvania. From 2003 to 2010, oil and gas pipeline employment grew at an average annual rate of 9 percent versus 6 percent for the nation. Employment in power line and related construction grew at an average annual rate of 4.6 percent in Pennsylvania as opposed to there being a slight decline in the nation. These trends are illustrated in Exhibit 6-12. These trends reflect a consistent pattern of growth in the electric power generation and distribution industry in Pennsylvania, as discussed above. The dramatic shift in oil and gas construction is clearly driven by the rapid expansion in the natural gas industry as the Marcellus Shale play became active.

Exhibit 6-12. Trends in energy infrastructure construction jobs: Pennsylvania vs. US
(Index 2003 = 100)



Average annual growth rate	
Oil & gas: PA	9.1%
Power: PA	4.6%
Oil & gas: US	5.9%
Power: US	-0.3%

Source: U.S. Census Bureau

The availability of abundant energy in Pennsylvania has been an impetus to statewide industrial development for centuries. The role of natural gas in industrial operations can be as a basic source of heat for industrial processes requiring high temperatures (e.g., glass manufacturing, primary metal production) or as an input into the manufactured products (e.g., certain types of plastics).

The processing of extracted forms of energy is another linked industry. Refining crude oil, processing natural gas, and processing coal are all longstanding industrial sectors in Pennsylvania that rely on the state's energy resources for inputs. Exhibit 6-13 traces employment in a selection of energy-intensive industries. The identification of industries is based on several recent reports which focus on paper, chemicals, plastics, glass,

cement, and metal production.[59] These are traditional mainstays of Pennsylvania's industrial base.

To facilitate comparisons between trends in Pennsylvania and the nation, employment in each industry has also been indexed with year 2000 employment levels set at 100. As shown in the table, employment has declined in all these industries both in the state and in the nation. Pennsylvania has fared better than the nation in most of these industries, however. For example, paper manufacturing in 2010 in Pennsylvania stood at 70.5 percent of its 2000 level, but was even lower in the nation as a whole (65.9 percent). Of the eight industries listed in the exhibit employment trends were more favorable in Pennsylvania compared to the nation in six industries (noted in bold face in the 2010 data). The national trend was more favorable only in petroleum and coal products and glass and glass products manufacturing.

Exhibit 6-13. Energy-intensive manufacturing: Pennsylvania vs. US

Manufacturing sector	*Employment*			*Indexed employment trends*		
	2000	*2005*	*2010*	*2000*	*2005*	*2010*
• Pennsylvania						
Paper	32.3	24.5	22.8	100.0	75.9	**70.5**
Petroleum and coal products	6.5	6.6	5.8	100.0	100.4	88.0
Chemical	34.8	38.7	32.8	100.0	111.1	**94.3**
Plastics and rubber products	50.9	44.7	36.0	100.0	87.9	**70.8**
Glass and glass product	13.2	7.5	6.2	100.0	57.0	46.9
Cement and concrete product	9.7	9.0	7.3	100.0	93.6	**75.1**
Primary metal	60.2	43.2	36.0	100.0	71.8	**59.8**
Fabricated metal product	102.9	88.4	74.8	100.0	85.9	**72.6**
Total	**310.5**	**262.7**	**221.6**	**100.0**	**84.6**	**71.4**
• United States						
Paper	553.9	454.0	365.1	100.0	82.0	65.9
Petroleum and coal products	109.2	101.5	99.7	100.0	92.9	91.3
Chemical	885.8	810.4	722.5	100.0	91.5	81.6
Plastics and rubber products	1,056.5	902.1	667.6	100.0	85.4	63.2
Glass and glass product	131.2	103.1	79.5	100.0	78.6	60.6
Cement and concrete product	216.7	216.4	154.3	100.0	99.8	71.2
Primary metal	601.6	450.8	352.3	100.0	74.9	58.6
Fabricated metal product	1,790.8	1,519.8	1,275.8	100.0	84.9	71.2
Total	**5,345.9**	**4,558.1**	**3,716.8**	**100.0**	**85.3**	**69.5**

Source: U.S. Census Bureau

[59] These industries have been recently cataloged in several publications. See Jaap B. Kalkman, Laurent Nordin, and Ahmed Yahia "Moving energy-intensive industries to the Gulf: Multinational producers of energy-intensive commodities must rethink their approach to crafting deals in the Gulf," McKinsey Quarterly, February 2007 http://www.mckinseyquarterly.com/Moving_energy-intensive_industries_to_the_Gulf_1921 and Ecorys Research and Consulting, "Study on European Energy- Intensive Industries – The Usefulness of Estimating Sectoral Price Elasticities," 16th of March 2009

The role that energy specifically played in the vitality of these industries in Pennsylvania is not known. Changes in demand, foreign competition, and other macro-level factors can overwhelm competitive advantages such as the availability and price of energy.

Nevertheless, the relatively sudden onset of abundant supplies of natural gas and its consequent sharp price decline have had and will have an effect on the location and level of manufacturing activity. Given the expected continued growth in Pennsylvania's natural gas industry, the state is likely to reap whatever benefits are available to industry.

There is every indication that those benefits will be substantial. In a series of reports on the economic impacts and potential of the Marcellus Shale natural gas industry, the forecasts of the benefits and impacts in 2020 have grown progressively larger. The most recent report estimated that by 2020, the industry would add $20 billion in value to the state economy, $2 billion in state and local taxes, and would support more than 256,000 jobs (including indirect jobs—the supply chain—and the induced jobs created by the spending of those in the industry and its supply chain).[60]

6.4 Significant Barriers and Bottlenecks

In recent years, energy infrastructure has frequently been an impediment to the most effective use of the energy that is produced. The bottlenecks may manifest themselves as congestion in the electrical grid or insufficient pipeline capacity to transport natural gas.

The electrical grid in Pennsylvania and in the PJM Interconnection region has accepted a certain level of congestion as an insoluble condition. As a result, electrical grid development focuses on major transmission projects such as the Susquehanna-Roseland project as feasible responses to the growing demand for electricity.

The problems associated with congestion are, however, ameliorated by success in load management and demand response initiatives. As noted above, the initial phase of Act 129 programs by Pennsylvania's larger EDCs had a goal of reducing peak demand by 4.5 percent. Evaluations of that initial phase have indicated substantial additional potential for cost-beneficial efforts at conservation and peak demand reduction. These successes will inevitably mitigate ongoing congestion problems, even if they are unlikely to resolve completely the ill effects of congestion.

Pressures to develop the natural gas resources in the Marcellus, Utica, and other unconventional shale formations create substantial demands for infrastructure that can move that resource from the wellhead to end users. Exceptional needs for gathering

[60] Considine, Thomas J., et al. (July 20, 2011). "The Pennsylvania Marcellus natural gas industry: status, economic impacts and future potential."

pipelines, estimated to range from 500 miles to 1,250 miles per year over a 20-year period from 2010 to 2030, represents a major barrier to the effective deployment of that energy resource.

Any such barriers to the effective transmission and distribution of natural gas will have an impact on the development of those industries that are particularly reliant on energy. Because the economic case for extracting this energy resource is so strong, the most likely impact of any barriers or bottlenecks created by infrastructure is to delay economic development rather than to prevent that development.

Conclusion

There are few if any industries as dynamic in energy. Both nationally and in Pennsylvania, production and consumption patterns are shifting, technologies are being diffused, and supportive public policies such as Act 129 are being developed. Though like most states Pennsylvania remains a net importer of energy, that status is unlikely to last indefinitely due to the rapid expansion of natural gas, renewable and other forms of energy production in the Commonwealth.

The implications of implementing forward-looking energy strategies in Pennsylvania are simply massive. Sound policy would promote greater energy exports, enhanced efficiency, an improved local and global environment, job creation, income formation and associated business development opportunities. This report serves as a foundational element to the strategies that will ultimately be developed, refined and implemented in the Commonwealth.

Data Appendix

Appendix 1: Energy Consumption

Exhibits 1 & 2. Pennsylvania Total Energy Consumption by Sector & Fuel Type, 2010 (trillion BTU)

Sector	Consumption	Share
Transportation	993.2	16.5%
Commercial	687.0	11.4%
Industrial	1,134.8	18.8%
Residential	943.9	15.7%
Electric power sector	2,264.7	37.6%
Total	6,023.6	100%

Fuel Type	Consumption	Share
Coal	1,311.0	29.4%
Natural Gas	889.2	20.0%
Petroleum	1,313.0	29.5%
Renewables	125.9	2.8%
Nuclear	813.5	18.3%
Total (1)	4,452.5	100%

Notes: (1) Total excludes electricity and electrical system losses.
Source: Energy Information Administration

Exhibits 1 &2. Pennsylvania Sectors Energy Consumption by Fuel Type, 2010 (trillion BTU)

	Transportation	Commercial	Residential	Industrial	Electric Power
Coal	-	4.2	0.5	186.5	1,119.8
Natural Gas	49.5	146.9	231.9	208.7	252.2
Petroleum	934.3	33.3	113.7	224.8	6.8
Renewables	-	5.4	17.7	31.8	71.1
Nuclear	-	-	-	-	813.5
Total (excluding electricity and losses)	983.9	189.7	363.8	651.7	2,263.3
Electricity (purchases)	3.0	161.6	188.5	5.9	-
Electrical system energy losses	6.3	335.6	391.5	155.1	-
Net electricity imports	-	-	-	-	1.4
Losses and co-products (1)	-	-	-	322.1	-
Total Energy Consumption	993.2	687.0	943.9	1,134.8	2,264.7

Notes: (1) Energy losses and co-products from the production of fuel ethanol.
Source: Energy Information Administration

Exhibit 1-3. Total energy consumption trends for Pennsylvania (trillions of BTU)					
Year	Transportation	Commercial	Industrial	Residential	Total
2000	1,000	701	1,282	945	3,928
2001	997	661	1,272	915	3,845
2002	1,001	696	1,260	948	3,905
2003	984	696	1,267	988	3,934
2004	1,019	703	1,288	985	3,994
2005	1,036	717	1,270	998	4,022
2006	1,032	689	1,265	909	3,895
2007	1,032	722	1,254	966	3,973
2008	999	707	1,230	948	3,883
2009	986	681	1,056	915	3,638
2010	993	687	1,135	944	3,759
2011	968	668	1,181	946	3,759
2012	978	679	1,217	956	3,759
2013	971	671	1,188	922	3,759
2014	966	675	1,218	915	3,759
2015	962	675	1,225	906	3,759
2016	956	680	1,220	903	3,759
2017	947	682	1,190	900	3,759
CAGR	*-0.32%*	*-0.16%*	*-0.44%*	*-0.29%*	*-0.26%*
Source: Energy Information Administration					

Exhibit 1-4. Total energy consumption trends

Pennsylvania and nearby states (trillions of BTU)

Year	MD	NJ	NY	OH	PA	US
2000	1,444	2,473	4,111	4,204	3,928	98,806
2001	1,420	2,451	3,947	3,943	3,845	96,142
2002	1,514	2,482	3,972	3,890	3,905	97,650
2003	1,556	2,513	4,105	3,945	3,934	97,977
2004	1,550	2,554	4,291	4,012	3,994	100,170
2005	1,586	2,661	4,146	4,017	4,022	100,277
2006	1,476	2,541	3,800	3,876	3,895	99,593
2007	1,521	2,677	3,941	4,056	3,973	101,273
2008	1,488	2,565	3,869	4,003	3,883	99,248
2009	1,469	2,365	3,750	3,696	3,638	94,531
2010	1,481	2,448	3,728	3,834	3,759	97,711

Pennsylvania, nearby states and US (indexed with 2000 = 100)

Year	MD	NJ	NY	OH	PA	US
2000	100	100	100	100	100	100
2001	98.4	99.1	96.0	93.8	97.9	97.3
2002	104.9	100.3	96.6	92.5	99.4	98.8
2003	107.8	101.6	99.9	93.8	100.2	99.2
2004	107.4	103.2	104.4	95.4	101.7	101.4
2005	109.9	107.6	100.8	95.5	102.4	101.5
2006	102.3	102.7	92.4	92.2	99.2	100.8
2007	105.4	108.2	95.9	96.5	101.1	102.5
2008	103.1	103.7	94.1	95.2	98.9	100.4
2009	101.7	95.6	91.2	87.9	92.6	95.7
2010	102.6	99.0	90.7	91.2	95.7	98.9

Source. Energy Information Administration

Exhibit 1-5. Energy consumption distribution by sector, Pennsylvania

	2000	2010	2017
Transportation	25.5%	26.4%	25.2%
Commercial	17.8%	18.3%	18.1%
Industrial	32.6%	30.2%	31.7%
Residential	24.1%	25.1%	23.9%

Source. Energy Information Administration

Exhibit 1-6. Total energy expenditure distribution by sector, Pennsylvania

	2000	2010
Transportation	37.3%	42.7%
Commercial	16.8%	14.3%
Industrial	17.8%	17.2%
Residential	28.1%	25.8%

Source. Energy Information Administration

Exhibit 1-7. Total energy expenditure trends in Pennsylvania (billions of dollars)

Year	Transportation	Commercial	Industrial	Residential	Total
2000	10.8	4.8	5.1	8.1	28.8
2001	10.1	5.4	5.6	8.7	29.7
2002	9.6	5.2	5.4	8.3	28.5
2003	10.9	5.6	6.1	9.3	31.9
2004	13.5	5.8	6.5	9.9	35.8
2005	17.4	6.5	7.6	11.1	42.5
2006	19.8	6.7	8.7	11.0	46.2
2007	21.1	7.0	8.8	11.9	48.8
2008	24.9	7.4	9.8	12.7	54.9
2009	17.4	6.7	7.4	11.7	43.2
2010	20.8	6.9	8.4	12.6	48.7
CAGR	*6.8%*	*3.7%*	*5.0%*	*4.5%*	*5.4%*

Source. Energy Information Administration

Exhibit 1-8. Total energy expenditure trends

Pennsylvania and nearby states (billions of dollars)

Year	MD	NJ	NY	OH	PA	U.S.
2000	11.2	20.3	39.1	29.2	28.8	685.9
2001	11.2	19.9	39.6	28.9	29.7	694.5
2002	10.8	19.0	36.5	27.4	28.5	662.4
2003	12.4	21.9	43.2	31.0	31.9	754.7
2004	14.1	26.2	48.2	34.6	35.8	871.1
2005	17.4	31.0	56.3	41.5	42.5	1046.9
2006	19.4	34.4	59.0	44.6	46.2	1159.7
2007	21.3	38.0	63.3	47.6	48.8	1234.3
2008	24.2	44.2	71.9	53.3	54.9	1408.8
2009	20.1	32.9	56.2	40.7	43.2	1061.2
2010	21.5	37.4	61.6	45.1	48.7	1204.8

Pennsylvania, nearby states and US (indexed with 2000 = 100)

Year	MD	NJ	NY	OH	PA	U.S.
2000	100	100	100	100	100	100
2001	99.7	97.9	101.2	99.0	103.1	101.3
2002	95.8	93.7	93.3	93.7	99.0	96.6
2003	110.5	107.6	110.3	106.1	110.6	110.0
2004	125.6	128.6	123.0	118.3	124.1	127.0
2005	155.2	152.4	143.9	141.9	147.4	152.6
2006	172.8	169.0	150.7	152.6	160.3	169.1
2007	189.6	187.0	161.6	163.0	169.4	180.0
2008	215.7	217.6	183.5	182.5	190.4	205.4
2009	179.2	161.8	143.6	139.3	149.8	154.7
2010	191.5	183.8	157.4	154.3	169.0	175.7

Source. Energy Information Administration

Exhibit 1-9. State gross domestic product trends (billions of 2010 dollars), Pennsylvania

2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
500.9	500.9	514.1	523.2	533.0	538.4	547.7	558.5	551.7	546.0	558.9	560.6

Source. Energy Information Administration

Exhibit 1-10. Energy consumption per dollar of state gross domestic product trends (BTUs per 2010 dollar), Pennsylvania

2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	CAGR
7840.4	7674.6	7596.9	7518.0	7494.2	7470.4	7110.9	7112.7	7038.3	6662.2	6725.2	-1.5%

Source. Energy Information Administration

Exhibit 1-11. Total energy consumed per dollar of real gross domestic product: Pennsylvania, nearby states and US

BTU per chained 2005 dollar

Year	MD	NJ	NY	OH	PA	US
2000	6,880	6,280	4,760	9,790	8,680	8,800
2001	6,490	6,090	4,400	9,380	8,470	8,480
2002	6,720	6,090	4,450	9,050	8,420	8,460
2003	6,740	6,050	4,590	9,090	8,330	8,270
2004	6,460	6,020	4,660	9,070	8,330	8,170
2005	6,390	6,180	4,310	9,030	8,330	7,940
2006	5,840	5,760	3,790	8,790	7,950	7,680
2007	5,910	6,020	3,860	9,160	7,960	7,660
2008	5,730	5,750	3,810	9,180	7,770	7,540
2009	5,700	5,520	3,800	8,850	7,400	7,440
2010	5,590	5,570	3,600	8,990	7,420	7,460

Indexed with 2000 = 100

Year	MD	NJ	NY	OH	PA	US
2000	100	100	100	100	100	100
2001	94	97	92	96	98	96
2002	98	97	93	92	97	96
2003	98	96	96	93	96	94
2004	94	96	98	93	96	93
2005	93	98	91	92	96	90
2006	85	92	80	90	92	87
2007	86	96	81	94	92	87
2008	83	92	80	94	90	86
2009	83	88	80	90	85	85
2010	81	89	76	92	85	85

Source. Energy Information Administration

Exhibit 1-12. Energy expenditures per billion BTU trends, Pennsylvania (current dollars)

2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	CAGR
7,336	7,730	7,303	8,100	8,955	10,561	11,862	12,288	14,131	11,864	12,956	5.9%

Source. Energy Information Administration

Exhibit 1-13. Total energy expenses per real state gross domestic product, Pennsylvania (2010 dollars)

2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	CAGR
0.073	0.073	0.067	0.072	0.078	0.088	0.091	0.092	0.101	0.080	0.087	1.8%

Source. Energy Information Administration

Exhibit 1-14. Total energy expenditure trends

Energy expenditures per billion BTU trends: Pennsylvania, nearby states and US (current dollars)

Year	MD	NJ	NY	OH	PA	US
2000	9,640	8,600	9,240	8,280	8,280	8,240
2001	9,690	8,450	9,560	8,730	8,650	8,430
2002	8,830	7,820	8,440	8,000	7,960	7,660
2003	10,230	9,510	10,110	9,510	9,280	9,150
2004	11,780	11,620	11,590	11,030	10,860	10,830
2005	14,750	13,630	14,410	14,020	13,710	13,660
2006	17,360	16,200	16,120	15,740	15,710	15,350
2007	17,940	16,470	17,050	16,270	16,260	16,250
2008	21,330	20,410	20,290	19,010	19,650	19,650
2009	15,870	14,790	15,170	14,280	15,310	14,150
2010	18,000	16,980	17,250	15,590	16,850	16,230

Total energy expenditures as percent of current-dollar GDP: Pennsylvania, nearby states and US

Year	MD	NJ	NY	OH	PA	US
2000	6.1	5.8	5.1	7.7	7.3	6.9
2001	5.7	5.5	4.9	7.6	7.3	6.8
2002	5.2	5.1	4.4	6.9	6.7	6.2
2003	5.7	5.6	5.1	7.6	7.2	6.8
2004	6.1	6.4	5.4	8.1	7.7	7.3
2005	7.0	7.2	5.9	9.3	8.8	8.3
2006	7.4	7.6	5.7	9.8	9.1	8.7
2007	7.8	8.1	5.8	10.2	9.2	8.8
2008	8.6	9.1	6.5	11.3	10.1	9.9
2009	7.1	7.0	5.1	8.8	7.9	7.6
2010	7.3	7.7	5.3	9.4	8.5	8.3

Source. Energy Information Administration

Exhibit 1-15. Pennsylvania Electricity Consumption (Sales) trends: 2001-2011 Actual, 2012-2017 Forecast (gigawatt hours), by sector					
Year	Other	Commercial	Industrial	Residential	Total
2001	1,193	39,856	47,100	43,714	134,228
2002	1,662	41,378	46,404	46,274	137,720
2003	1,395	41,607	46,023	47,035	137,972
2004	1,319	42,825	46,916	47,944	141,070
2005	1,378	44,358	47,233	50,976	145,938
2006	1,287	44,602	47,367	49,438	144,951
2007	1,363	45,980	47,718	51,693	149,041
2008	1,343	45,879	47,461	51,321	148,328
2009	1,366	44,922	43,023	50,229	141,822
2010	1,128	39,258	51,199	52,534	145,716
2011	1,344	42,255	48,313	52,178	148,671
2012	1,152	42,080	48,383	50,566	142,181
2013	1,153	42,463	49,015	50,518	143,149
2014	1,154	42,965	49,579	50,751	144,449
2015	1,154	43,515	50,124	51,123	145,916
2016	1,156	43,976	50,470	51,564	147,166
2017	1,157	44,463	51,006	51,817	148,442
Source. Pennsylvania PUC, Electric Power Outlook for Pennsylvania					

Electricity Sales 2001-2011 (gigawatt hours)											
	Total Customers Served	Residential	Commercial	Industrial	Other	Sales for Resale	Total Consumption	System Losses	Company Use	Net Energy for Load	Peak Load (MW)
2001	5,391,548	43,714	39,856	47,100	1,193	2,365	134,228	8,966	228	138,328	26,994
2002	5,428,763	46,274	41,378	46,404	1,662	2,002	137,720	9,957	250	147,928	27,975
2003	5,464,420	47,035	41,607	46,023	1,395	1,912	137,972	9,640	223	147,835	26,836
2004	5,501,897	47,944	42,825	46,916	1,319	2,066	141,070	10,440	176	151,686	26,958
2005	5,537,992	50,976	44,358	47,233	1,378	1,992	145,938	10,340	147	156,425	28,850
2006	5,574,740	49,438	44,602	47,367	1,287	2,257	144,951	9,613	124	154,688	30,264
2007	5,600,405	51,693	45,980	47,718	1,363	2,286	149,041	11,226	128	160,395	29,001
2008	5,625,594	51,321	45,879	47,461	1,343	2,324	148,328	8,919	173	157,420	30,050
2009	5,627,584	50,229	44,922	43,023	1,366	2,282	141,822	8,119	167	150,108	27,597
2010	5,645,654	52,534	39,258	51,199	1,128	1,597	145,716	9,051	171	154,937	29,515
2011	5,748,281	52,178	42,255	48,313	1,344	4,585	148,671	9,252	151	157,054	31,192
Note. For some EDCs, "company use" is included in "system losses."											
Source. Pennsylvania PUC, Electric Power Outlook for Pennsylvania.											

Exhibit 1-16. Total electricity consumption trends: Pennsylvania, nearby states and US

Gigawatt hours

Year	MD	NJ	NY	OH	PA	U.S.
2000	60,678	69,977	142,027	165,195	N/A	3,421,414
2001	61,640	73,177	144,181	155,798	134,228	3,394,458
2002	68,380	74,603	147,440	153,407	137,720	3,465,466
2003	71,259	76,383	144,045	152,230	137,972	3,493,807
2004	66,892	77,593	145,082	154,221	141,070	3,547,479
2005	68,365	81,897	150,148	160,176	145,938	3,660,969
2006	63,173	79,681	142,238	153,429	144,951	3,669,919
2007	65,391	81,934	148,178	161,771	149,041	3,764,561
2008	63,326	80,520	144,053	159,389	148,328	3,732,962
2009	62,589	75,780	140,034	146,300	141,822	3,596,865
2010	65,335	79,179	144,624	154,145	145,716	3,754,493

Indexed with 2001 = 100

Year	MD	NJ	NY	OH	PA	U.S.
2001	100	100	100	100	100	100
2002	110.9	101.9	102.3	98.5	102.6	102.1
2003	115.6	104.4	99.9	97.7	102.8	102.9
2004	108.5	106.0	100.6	99.0	105.1	104.5
2005	110.9	111.9	104.1	102.8	108.7	107.9
2006	102.5	108.9	98.7	98.5	108.0	108.1
2007	106.1	112.0	102.8	103.8	111.0	110.9
2008	102.7	110.0	99.9	102.3	110.5	110.0
2009	101.5	103.6	97.1	93.9	105.7	106.0
2010	106.0	108.2	100.3	98.9	108.6	110.6

Sources: Energy Information Administration, Pennsylvania PUC, Electric Power Outlook for Pennsylvania.

Exhibit 1-17. Total electricity consumption by sector, Pennsylvania (gWh)

Year	Transportation/Other	Commercial	Industrial	Residential
2001	0.89%	29.7%	35.1%	32.6%
2011	0.90%	28.4%	32.5%	35.1%

Source. Pennsylvania PUC, Electric Power Outlook for Pennsylvania.

*Percentages do not sum to 100% (the remainder is 'Sales for Resale') *see exhibit above "Electricity Sales 2001-2011 ()"

Exhibit 1-18. Electricity expenditures trends, Pennsylvania (billions of dollars)					
Year	Transportation	Commercial	Industrial	Residential	Total
2000	0.027	3.3	2.5	4.3	10.2
2001	0.031	3.6	2.7	4.5	10.7
2002	0.029	3.7	2.7	4.7	11.2
2003	0.057	3.7	2.6	4.8	11.2
2004	0.060	3.8	2.7	4.9	11.4
2005	0.064	3.9	2.9	5.3	12.1
2006	0.061	4.1	3.1	5.4	12.6
2007	0.068	4.4	3.2	6.0	13.6
2008	0.065	4.4	3.2	6.1	13.9
2009	0.068	4.4	3.0	6.2	13.6
2010	0.070	4.8	3.4	7.0	15.2
2011	0.068	4.4	3.8	7.3	15.6
Source. Energy Information Administration					

Exhibit 1-19. Total electricity expenditure trends: Pennsylvania, nearby states and US						
Billions of dollars						
Year	MD	NJ	NY	OH	PA	U.S.
2000	4	7	16	10	10	232
2001	4	7	17	10	11	245
2002	4	7	16	10	11	248
2003	5	7	18	10	11	258
2004	5	8	18	11	11	268
2005	6	9	21	11	12	296
2006	6	9	22	12	13	324
2007	8	11	23	13	14	341
2008	8	12	24	13	14	361
2009	8	11	22	13	14	350
2010	8	12	24	14	15	366
Indexed with 2000 = 100						
Year	MD	NJ	NY	OH	PA	U.S.
2000	100	100	100	100	100	100
2001	99	103	103	97	106	106
2002	103	105	102	98	110	107
2003	113	109	111	97	110	111
2004	117	121	113	100	112	116
2005	136	134	130	107	119	128
2006	154	143	135	112	124	140
2007	184	161	140	121	134	147
2008	202	176	148	126	137	156
2009	200	166	135	124	134	151
2010	203	176	147	133	150	158
Source. Energy Information Administration						

Exhibit 1-20. Electricity expenditures distribution by sector, Pennsylvania				
Year	Transportation	Commercial	Industrial	Residential
2000	0.3%	32.9%	24.6%	42.2%
2011	0.4%	28.0%	24.6%	46.9%
Source. Energy Information Administration				

Exhibit 1-21. Pennsylvania transportation sector consumption by fuel type (trillions of BTUs)						
Year	Natural gas	Fuel oil	Jet fuel	Gasoline	Other petroleum (1)	Electricity
2000	40.2	198.0	107.8	610.5	8.6	1.4
2001	35.3	206.3	107.0	619.8	7.9	1.4
2002	39.0	202.9	96.4	631.5	7.9	1.4
2003	35.4	184.9	99.1	629.6	7.5	2.5
2004	30.7	213.8	92.9	639.0	7.6	2.8
2005	32.3	226.0	95.4	636.0	7.8	3.0
2006	28.8	237.1	93.4	628.8	7.5	2.8
2007	36.5	229.9	87.9	638.5	7.5	3.0
2008	39.0	212.7	81.8	624.7	7.7	2.9
2009	43.3	207.5	70.7	632.3	6.7	3.0
2010	49.5	215.9	70.6	633.9	7.4	3.0
2011	45.7	187.1	72.1	619.1	7.2	2.9
2012	50.2	202.6	72.9	618.8	7.2	2.9
2013	48.0	206.4	74.8	616.7	7.2	3.0
2014	48.4	211.0	76.7	616.9	7.2	3.0
2015	48.7	210.4	78.2	617.8	7.1	3.1
2016	48.7	209.5	79.1	618.1	7.1	3.1
2017	48.9	208.4	79.4	617.8	7.0	3.2
CAGR	*1.16%*	*0.30%*	*-1.78%*	*0.07%*	*-1.2%*	*5.0%*
Source. Energy Information Administration Notes: 1. Other petroleum includes LPG and Lubricants						

Exhibit 1-22. Pennsylvania commercial sector consumption by fuel type (trillions of BTUs)					
Year	Electricity	Natural gas	Coal	Petroleum	Wood
2000	146.7	150.4	17.4	44.6	6.1
2001	141.4	143.9	17.6	45.9	4.4
2002	148.8	141.3	13.0	53.8	4.5
2003	147.5	155.4	15.3	49.3	4.7
2004	151.3	148.2	15.4	49.6	4.4
2005	156.2	150.8	14.4	48.2	4.6
2006	155.7	135.4	14.3	44.0	4.4
2007	162.2	151.5	16.2	39.3	4.5
2008	161.5	150.2	4.7	37.9	4.7
2009	158.4	149.8	4.5	34.5	4.6
2010	161.6	146.9	4.2	33.3	4.6
2011	158.4	149.2	4.2	31.9	4.6
2012	158.1	157.0	4.2	30.9	4.6
2013	158.3	154.9	4.2	30.4	4.6
2014	159.3	156.1	4.2	29.8	4.6
2015	160.2	157.1	4.1	29.3	4.6
2016	161.2	158.2	4.1	29.0	4.6
2017	162.3	159.4	4.1	28.8	4.6
CAGR	*0.60%*	*0.34%*	*-8.10%*	*-2.55%*	*-1.56%*
Source. Energy Information Administration					

Exhibit 1-24. Pennsylvania industrial sector consumption by fuel type (trillions of BTUs)					
Year	Electricity	Natural gas	Coal	Petroleum	Wood
2000	155.1	243.6	277.9	213.2	38.0
2001	161.7	214.6	266.0	242.8	35.6
2002	160.7	220.5	267.7	219.3	30.2
2003	159.6	208.2	274.0	244.0	31.1
2004	162.6	207.9	273.4	253.0	32.3
2005	163.6	197.5	250.3	267.8	32.6
2006	163.5	202.5	240.5	275.9	30.3
2007	165.8	203.7	232.3	266.9	30.0
2008	164.2	205.2	227.3	249.9	30.4
2009	148.6	193.1	147.9	227.2	30.7
2010	155.1	208.7	186.5	224.8	31.8
2011	159.1	232.6	207.4	228.6	31.8
2012	161.1	250.0	214.3	230.7	31.8
2013	156.4	248.7	198.0	232.0	31.8
2014	159.1	258.2	198.0	240.5	31.8
2015	159.9	264.0	190.4	244.9	31.8
2016	158.9	267.5	180.0	245.5	31.8
2017	157.2	268.5	170.9	232.3	31.8
CAGR	*0.08%*	*0.57%*	*-2.82%*	*0.51%*	*-1.06%*
Source. Energy Information Administration					

Exhibit 1-25. Pennsylvania residential sector consumption by fuel type (trillions of BTUs)					
Year	Electricity	Natural gas	Coal	Petroleum	Wood
2000	153.6	272.0	2.2	152.3	13.6
2001	157.1	251.9	2.2	149.3	12.5
2002	166.3	248.1	1.8	143.8	12.7
2003	169.4	275.6	2.3	155.1	13.3
2004	172.9	257.5	1.7	157.5	13.7
2005	183.1	255.0	1.3	141.3	15.4
2006	176.7	213.8	1.4	121.5	13.7
2007	186.3	240.2	1.8	122.5	14.8
2008	184.5	238.2	0.5	110.1	16.2
2009	180.5	236.8	0.6	104.9	15.5
2010	188.5	231.9	0.5	113.7	15.1
2011	190.3	238.2	0.5	113.0	15.1
2012	185.0	251.1	0.6	114.2	15.1
2013	183.1	240.0	0.5	106.0	15.1
2014	181.6	239.8	0.5	103.4	15.1
2015	180.3	238.9	0.5	100.7	15.1
2016	180.0	238.5	0.5	98.3	15.1
2017	180.5	238.1	0.5	96.3	15.1
CAGR	*0.95%*	*-0.78%*	*-8.03%*	*-2.66%*	*0.64%*
Source. Energy Information Administration					

Exhibit 1-26. Energy price trends in Pennsylvania (dollars per million BTU)									
Year	Coal	Natural Gas	Petroleum	Nuclear Fuel	Biomass	Total Primary	Electric Power Sector	Retail Electricity	Total Energy
2000	1.23	6.81	10.47	0.48	1.34	4.78	1	22.43	10.64
2001	1.31	9.33	9.79	0.37	1.86	5.04	1.02	23.49	11.21
2002	1.36	7.37	9.42	0.4	2	4.58	1.03	23.66	10.76
2003	1.33	9.06	10.88	0.38	1.98	5.34	1.09	23.56	11.78
2004	1.52	10.03	12.83	0.36	2.08	6.18	1.27	23.53	13.11
2005	1.79	12.19	16.24	0.37	3.02	7.7	1.61	24.33	15.66
2006	1.94	12.89	19.01	0.4	3.09	8.59	1.56	25.5	17.54
2007	1.98	11.45	20.59	0.44	3.26	8.87	1.73	26.69	18.25
2008	2.4	13.09	25.47	0.46	3.81	10.65	2.1	27.42	21.17
2009	2.55	9.75	18.45	0.53	3.09	8.25	1.88	28.24	17.9
2010	2.75	8.75	21.97	0.61	3.37	9.06	2.1	30.29	19.56
Source. Energy Information Administration									

Exhibit 1-28. Selected energy prices in Pennsylvania: 2000 to 2017 (dollars per million BTU)			
Year	Coal	Natural Gas	Retail Electricity
2000	1.2	6.8	22.4
2001	1.3	9.3	23.5
2002	1.4	7.4	23.7
2003	1.3	9.1	23.6
2004	1.5	10.0	23.5
2005	1.8	12.2	24.3
2006	1.9	12.9	25.5
2007	2.0	11.5	26.7
2008	2.4	13.1	27.4
2009	2.6	9.8	28.2
2010	2.8	8.8	30.3
2011	2.7	8.2	29.6
2012	2.7	8.1	28.7
2013	2.7	8.0	28.5
2014	2.7	7.9	28.3
2015	2.8	7.9	28.4
2016	2.8	7.9	28.1
2017	2.8	7.9	28.0
CAGR	*5.0%*	*0.8%*	*1.3%*
Source. Energy Information Administration			

Exhibit 1-29. Total energy price in Pennsylvania, nearby states, and the U.S. (dollars per million BTUs)						
Year	MD	NJ	NY	OH	PA	U.S.
2000	11.8	11.1	13.2	10.4	10.6	10.3
2001	11.8	11.1	13.7	10.8	11.2	10.7
2002	11.1	10.6	12.7	10.3	10.8	10.1
2003	12.3	12.2	14.4	11.5	11.8	11.4
2004	13.8	14.3	15.6	12.8	13.1	12.9
2005	16.8	16.3	19.0	15.4	15.7	15.6
2006	20.0	19.0	21.1	17.1	17.5	17.4
2007	21.5	19.6	21.9	17.7	18.3	18.2
2008	25.1	23.6	25.2	20.2	21.2	21.4
2009	20.8	18.9	20.4	16.8	17.9	17.0
2010	22.5	20.9	22.9	17.9	19.6	18.7
CAGR	*6.6%*	*6.6%*	*5.7%*	*5.6%*	*6.3%*	*6.2%*
Source. Energy Information Administration						

Appendix 2: Energy Production

Exhibit 2-1. Total coal production			
	PA (millions of short tons)	PA vs. U.S. (indexed with 2000 = 100)	
		PA	US
2000	79.03	100.0	100.0
2001	80.09	101.3	105.0
2002	74.31	94.0	101.9
2003	71.99	91.1	99.8
2004	78.98	99.9	103.6
2005	79.54	100.7	105.4
2006	77.00	97.4	108.3
2007	76.65	97.0	106.8
2008	76.12	96.3	109.1
2009	66.85	84.6	100.1
2010	66.34	83.9	101.0
2011	67.93	86.0	101.8
2012	63.29	80.1	97.6
2013	67.93	86.0	96.5
2014	59.76	75.6	94.9
2015	59.76	75.6	92.5
2016	57.25	72.4	93.5
2017	57.48	72.7	93.6
Notes: Total Pennsylvania production for 2003 is only for underground and surface mines, coal refuse tonnage was not reported.			
Sources: U.S. figures-Energy Information Administration; Pennsylvania figures- Pennsylvania Department of Environmental Protection, 2011 Annual Historical Report.			

Exhibit 2-4. Total natural gas production			
	PA (billions of cubic feet)	PA vs. U.S. (indexed with 2000 = 100)	
		PA	*Lower 48*
2000	150	100	100
2001	130.9	87.2	102.2
2002	157.8	105.2	98.6
2003	159.8	106.6	99.4
2004	197.2	131.5	96.7
2005	168.5	112.3	93.8
2006	176.0	117.3	96.4
2007	182.3	121.5	100.5
2008	198.3	132.2	105.4
2009	273.9	182.6	107.7
2010	572.9	381.9	113.1
2011	719.9	479.9	120.6
2012	874.4	583.0	124.4
2013	904.6	603.1	119.7
2014	976.2	650.8	121.7
2015	1047.8	698.5	124.5
2016	1115.7	743.8	126.4
2017	1191.0	794.0	127.6
Notes: (a) Marketed production.			
Source. Energy Information Administration			

Exhibit 2-8. Total crude oil production			
	PA (thousands of barrels)	PA vs. U.S. (indexed with 2000 = 100)	
		PA	U.S.
2000	1,500	100	100
2001	1,620	108	99.7
2002	2,233	148.9	98.7
2003	2,425	161.7	97.6
2004	2,538	169.2	93.1
2005	3,947	263.1	88.9
2006	3,626	241.7	87.6
2007	3,653	243.5	87.0
2008	3,611	240.7	85.3
2009	3,541	236.1	92.1
2010	3,474	231.6	94.0
2011	3,474	231.6	95.7
2012	3,474	231.6	98.6
2013	2,606	173.7	101.4
2014	3,040	202.7	103.1
2015	3,040	202.7	105.6
2016	3,474	231.6	110.3
2017	3,908	260.6	111.1
Notes: (a) Includes lease condensate.			
Source. Energy Information Administration			

Exhibit 2-9. Total biodiesel production					
Production in Pennsylvania (millions of gallons)	2008	2009	2010	2011	2012
January - June	14.5	11.4	12.3	17.6	22.8
January - December	25.3	29.1	29.8	41.5	
Share of capacity used	2008	2009	2010	2011	2012
January - June	34.3%	23.6%	25.2%	33.1%	56.0%
January - December	30.0%	30.2%	31.2%	39.0%	
Source. Pennsylvania Department of Agriculture					

Landfill gas/methane production				
Project status	Number of projects	Generating capacity (total MMscfy used)		
		2010	2015	2017
Active projects	42	37,266	37,266	37,266
Planned projects	4		3,019	3,019
Potential projects	28			17,102
Theoretical total	74	37,266	40,285	57,387
Note. MMscfy = million standard cubic feet per year.				
Source. Pennsylvania Department of Environmental Protection				

2009 Active Landfill Methane Projects

Landfill	No. of Projects	Date	LFG Generation	LFG Project Use	LFG Flared	MW	Billion BTU	Estimated Max kWh	Reported kWh
			(MMscfy)						
Alliance	1	2010	3,772	2,712	1,060	15	1,220	123,516,000	396,236,811
Arden	1	2009	1,010	827	183	5	372	39,525,120	
Bethlehem	1	2008	1,111	926	185	5	417	41,995,440	44,000,000
Bruner	1	2005	151	130	21		59	0	
Chrin Brothers Sanitary	1	2011	1,682	631	1,051	3	284	26,350,080	
Commonwealth Env. Systems	2	2003	2,365	262			118	0	
		2008	2,103	1,789	314	11	805	90,578,400	
Frey Farm & Creswell*	1	2006	596	436	160	3	196	26,350,080	12,953,423
Conestoga	1	2009	3,820	1,309	2,511		589	0	
Cumberland County	1	2008	1,846	1,292	554	6	581	52,700,160	47,654,400
Grand Central Sanitary	1	2001	1,691	1,426	265	10	642	81,520,560	51,245,338
Greater Lebanon Refuse Auth.	1	2008	339	339	0	3	153	26,350,080	14,737,676
Greenridge Reclamation	1	2001	1,051	263	788		118	0	
GROWS and…	1	1988	2,633	2,633	0	14	1,185	115,281,600	
…GROWS North	1	2009	527	527	0		237		
…Tullytown	1	1997	3,739	3,739	0	16	1,683	131,750,400	
Imperial	1	2007	3,258	908	2,350		409		
Keystone Sanitary	1	1994	3,311	3,161	150	6	1,422	46,112,640	42,568,000
Lake View	1	1997	1,026	939	87	6	423	50,229,840	49,832,555
Lanchester	2	2004	1,435	1,151			518		
		2005	284	230	54	3	104	26,350,080	11,878,747
Laurel Highlands	1	2006	874	849	25		382		
Lycoming County RMS	2	1993	1,051	213	838	1	96	8,893,152	
		2003	838	7	831		3		
Modern	1	1998	2,600	886	1,714	9	399	75,344,760	13,405,126
Monroeville	1	1999	838	297	541		134		
Mostoller*	1	2010	2,492	2,492	0	5	1,121	40,348,560	
Mountain View Reclamation	1	2003	1,502	104	1,398	2	47	13,175,040	6,308,683
Northern Tier SWA	1	2009	289	289	0	2	130	13,175,040	12,391,170
Pine Grove	2	2008	636	0			0		
		2008	636	249	387	6	112	49,406,400	2,997,000
Pioneer Crossing	1	2008	1,625	1,064	561	6	479	52,700,160	50,097,180
Pottstown	1	1989	792	730	62	3	329	25,526,640	
SECCRA	1	2007-10	252	239	13	2	108	15,645,360	130,096,463
Seneca	2	2009	1,001	43		0	19	2,758,524	810,000
		2011	958	958	0		431		
Shade	1	2007	1,716	784	932		353		
South Hills	1	2008	265	67	198		30		
Southern Alleghenies	1	2007	768	630	138		284		
Valley	1	2002	603	229	374		103		
Veolia Greentree	1	2007	1,592	1,274	318		573		
Wayne Township	1	1999	594	232	362		104		
38	42		59,672	37,266	18,425	143	16,770	1,175,584,116	887,212,572

* Mostoller landfill provides methane to SCI Laurel Highlands. SCI Laurel uses the gas for electrical generation and as boiler fuel so the project includes electrical generation (EG) as well as direct thermal(DT) use.

2008 Planned Landfill Methane Projects

						Energy Produced		
Landfill	No. of Projects	Date	LFG Generation	LFG Project Use	LFG Flared	MW	Billion BTU	Estimated Max kWh
			(MMscfy)					
Blue Ridge	1	2013	1,073	1,073	0	6	483	52,700,160
Cumberland County	1	2011	554	554	0	5	249	39,525,120
Lycoming County RMS	1	2013	831	831	0	6	374	52,700,160
Pioneer Crossing	1	2015	561	561	0	3	252	27,996,960
5	4		3,019	3,019	0	21	1,359	172,922,400

2010 Potential Landfill Methane Project Sites

					Energy Not Used	
Landfill	No. of Projects	LFG Generation	LFG Project Use	LFG Flared	MW	Billion BTU
		(MMscfy)				
Alliance	1	1,060	0	1,060	6	477
Bethlehem	1	185	0	185		83
Chrin	1	1,051	0	1,051	6	473
Conestoga	1	2,511	0	2,511	12	1,130
Commonwealth Env. Systems	1	314	0	314	3	141
County		1,025	0	1,025	6	461
Dauphin Meadows		205	0	205		92
Evergreen		337	0	337	3	152
Greenridge	1	788	0	788	4	355
Grand Central Sanitary	1	265	0	265		119
Imperial	1	2,350	0	2,350		1,058
Kelly Run		244	0	244		110
Lake View		87	0	87		39
McKean County		240	0	240		108
Modern	1	1,714	0	1,714	6	771
Monroeville	1	541	0	541	6	243
Mountain View Reclamation	1	1,398	0	1,398		629
Northwest Sanitary		341	0	341		153
Pioneer Crossing	1	561	0	561	3	252
Rolling Hills		307	0	307		138
Sanitary		630	0	630	4	284
South Hills	1	198	0	198		89
Southern Alleghenies	1	138	0	138	3	62
Valley	1	374	0	374	3	168
Veolia Chestnut Valley		538	0	538	3	242
Veolia Greentree	1	318	0	318	3	143
Wayne Township	1	362	0	362		163
Western Berks		80	0	80		36
28	16	17,102	0	17,102	65	7,696

Source: Pennsylvania Department of Environmental Protection. "2010 Landfill methane summary statistics."

Appendix 3: Electricity Generation

Exhibit 3-1. Electricity generation by fuel type (billions of kilowatt hours)								
	Coal	Natural Gas	Nuclear Power	Petroleum	All Renewable Sources	*Hydroelectric*	*Other Biomass (a)*	Total
2000	116.2	2.7	73.8	3.7	5.0	*2.3*	*2*	201.7
2001	111.9	3	73.7	3.6	3.5	*1.7*	*1.3*	196.6
2002	113.9	6.7	76.1	2.7	4.3	*2.2*	*1.2*	204.3
2003	116	5.5	74.4	4.5	5.4	*3.3*	*1.3*	206.3
2004	117.2	9.8	77.5	4.1	5.4	*3.2*	*1.3*	214.7
2005	120.9	10.8	76.3	4.9	4.6	*2.2*	*1.4*	218.1
2006	122.6	13.5	75.3	1.5	5.3	*2.8*	*1.4*	218.8
2007	122.7	19.2	77.4	1.5	4.8	*2.2*	*1.5*	226.1
2008	117.6	18.7	78.7	0.9	5.4	*2.5*	*1.4*	222.4
2009	105.5	29.2	77.3	0.9	6.0	*2.7*	*1.6*	219.5
2010	110.4	33.7	77.8	0.6	6.6	*2.3*	*1.7*	229.8
2011	100.5	42.4	76.1	0.4	7.3	*3.2*	*1.7*	227.6
2012	95.9	44.5	79	0.4	7.0	*3.2*	*1.6*	228.7
2013	93.9	48.2	78.6	0.4	7.2	*3.2*	*1.6*	229.8
2014	89.7	51.3	79.3	0.4	7.7	*3.2*	*1.7*	230.3
2015	88.8	52.5	79.3	0.4	10.0	*3.2*	*2.3*	232.9
2016	86.5	52.7	80.7	0.4	11.3	*3.2*	*2.6*	234.4
2017	80.8	54.2	80.7	0.4	11.1	*3.2*	*2.5*	230.4
CAGR								
2000-2010	-0.5%	28.7%	0.5%	-17.1%	2.7%	0.2%	-1.7%	1.31%
2010-2017	-4.4%	7.0%	0.5%	-5.6%	7.7%	4.8%	5.6%	0.04%
2000-2017	-2.1%	19.3%	0.5%	-12.6%	4.8%	2.1%	1.2%	0.79%
Exhibit 3-4. Shares of electricity generation by fuel type in Pennsylvania								
2000	57.6%	1.3%	36.6%	1.8%	2.5%	1.1%	1.0%	1.0
2010	48.1%	14.7%	33.9%	0.3%	2.9%	1.0%	0.7%	1.0
2017	35.1%	23.5%	35.0%	0.2%	4.8%	1.4%	1.1%	1.0
Notes: (a) (Non-Woody)								
Source. Energy Information Administration								

Exhibit 3-2 & 3-3. Pennsylvania electricity generation trends by fuel type (indexed 2000 = 100)							
	Coal	Natural Gas	Nuclear Power	Petroleum	All Renewable Sources	*Hydroelectric*	*Other Biomass (a)*
2000	100	100	100	100	100	*100*	*100*
2001	96.3	112.5	99.9	95	70.6	*72.0*	*63.5*
2002	98	248.8	103.1	72.9	85.1	*96.5*	*61.0*
2003	99.8	204.5	100.8	121	108.4	*146.1*	*61.6*
2004	100.8	363.6	105	110.5	108.2	*137.8*	*63.6*
2005	104.1	400.4	103.4	131.8	90.9	*97.5*	*66.9*
2006	105.5	501.7	102.1	40.5	105.9	*124.2*	*70.4*
2007	105.6	711.3	104.9	39.6	95.2	*97.6*	*71.8*
2008	101.2	694	106.6	25	106.6	*111.3*	*69.8*
2009	90.8	1082.4	104.8	24.4	120.2	*117.1*	*77.9*
2010	95	1249.2	105.5	15.2	131.0	*101.8*	*84.2*
2011	86.5	1569.8	103.2	11.3	145.7	*140.5*	*81.5*
2012	82.5	1650.5	107.1	10.7	139.4	*140.5*	*78.0*
2013	80.8	1785.2	106.5	10.6	143.3	*141.2*	*80.1*
2014	77.2	1902.5	107.5	10.4	153.7	*141.6*	*85.9*
2015	76.4	1943.4	107.5	10.6	198.4	*141.6*	*111.0*
2016	74.5	1951.4	109.4	10.5	225.8	*141.7*	*126.3*
2017	69.5	2008.2	109.4	10.2	220.6	*141.7*	*123.4*
Notes: (a) (Non-Woody)							
Source. Energy Information Administration							

Electricity generation trends by fuel type, year-year % change, Pennsylvania							
	Coal	Hydroelectric	Natural Gas	Nuclear Power	Other Biomass (a)	Petroleum	Renewable Sources
2000	-	-	-	-	-	-	-
2001	-3.7%	-28.0%	12.5%	-0.1%	-36.5%	-5.0%	-29.4%
2002	1.8%	34.0%	121.2%	3.2%	-3.9%	-23.3%	20.5%
2003	1.8%	51.4%	-17.8%	-2.3%	1.0%	66.0%	27.4%
2004	1.0%	-5.7%	77.8%	4.2%	3.1%	-8.7%	-0.2%
2005	3.2%	-29.3%	10.1%	-1.5%	5.3%	19.3%	-16.0%
2006	1.3%	27.4%	25.3%	-1.3%	5.2%	-69.3%	16.6%
2007	0.1%	-21.4%	41.8%	2.8%	2.0%	-2.3%	-10.1%
2008	-4.2%	14.0%	-2.4%	1.7%	-2.8%	-36.8%	11.9%
2009	-10.3%	5.3%	56.0%	-1.7%	11.5%	-2.4%	12.7%
2010	4.6%	-13.1%	15.4%	0.6%	8.2%	-37.6%	9.0%
2011	-8.9%	27.9%	25.7%	-2.2%	5.5%	-26.2%	11.2%
2012	-4.6%	0.0%	5.1%	3.7%	-4.3%	-4.6%	-5.2%
2013	-2.1%	0.5%	8.2%	-0.5%	2.8%	-1.2%	2.8%
2014	-4.5%	0.3%	6.6%	0.9%	7.2%	-1.9%	7.2%
2015	-1.0%	0.0%	2.1%	0.0%	29.1%	1.5%	29.1%
2016	-2.6%	0.0%	0.4%	1.8%	13.8%	-0.7%	13.8%
2017	-6.6%	0.0%	2.9%	0.0%	-2.3%	-2.6%	-2.3%
Notes: (a) (Non-Woody)							
Source. Energy Information Administration							

Exhibit 3-6. Total electricity generation trends: Pennsylvania, nearby states and US

Billions of kilowatt hours

Year	MD	NJ	NY	OH	PA	U.S.
2000	51.1	58.1	138.1	149.1	201.7	3,802.1
2001	49.1	59.4	143.9	142.3	196.6	3,736.6
2002	48.3	61.6	139.6	147.1	204.3	3,858.5
2003	52.2	57.4	137.6	146.6	206.3	3,883.2
2004	52.1	55.9	138.0	148.3	214.7	3,970.6
2005	52.7	60.5	146.9	157.0	218.1	4,055.4
2006	49.0	60.7	142.3	155.4	218.8	4,064.7
2007	50.2	62.7	145.9	155.2	226.1	4,156.7
2008	47.4	63.7	140.3	153.4	222.4	4,119.4
2009	43.8	61.8	133.2	136.1	219.5	3,950.3
2010	43.6	65.7	137.0	143.6	229.8	4,125.1
2011	41.8	64.7	137.6	135.6	227.6	4,100.7

Indexed with 2000 = 100

Year	MD	NJ	NY	OH	PA	U.S.
2000	100	100	100	100	100	100
2001	95.9	102.3	104.2	95.4	97.5	98.3
2002	94.4	106.0	101.1	98.7	101.3	101.5
2003	102.1	98.8	99.7	98.4	102.3	102.1
2004	101.8	96.2	99.9	99.5	106.4	104.4
2005	103.0	104.2	106.4	105.3	108.1	106.7
2006	95.7	104.5	103.0	104.3	108.5	106.9
2007	98.1	107.9	105.6	104.1	112.1	109.3
2008	92.6	109.6	101.6	102.9	110.2	108.3
2009	85.6	106.4	96.4	91.3	108.8	103.9
2010	85.3	113.1	99.2	96.3	113.9	108.5
2011	81.8	111.4	99.7	91.0	112.9	107.9

Source. Energy Information Administration

Exhibit 3-7. Electricity generation trends by renewables, Pennsylvania (billions of kilowatt hours)

	Hydroelectric/ Hydro Conventional	Solar	Wind	Wood	MSW biogenic/landfill gas and other biomass (a)	Total
2000	2.29	-	0.01	0.69	2.03	5.02
2001	1.65	-	0.01	0.60	1.29	3.55
2002	2.21	-	0.06	0.77	1.24	4.27
2003	3.35	-	0.11	0.74	1.25	5.44
2004	3.16	-	0.31	0.68	1.29	5.43
2005	2.23	-	0.28	0.69	1.36	4.56
2006	2.84	-	0.36	0.68	1.43	5.32
2007	2.24	-	0.47	0.62	1.46	4.78
2008	2.55	0.00	0.73	0.66	1.42	5.35
2009	2.68	0.00	1.07	0.69	1.58	6.03
2010	2.33	0.01	1.85	0.67	1.71	6.58
2011	3.21	0.023	1.79	0.63	1.65	7.3

Exhibit 3-8. Distribution of renewable electricity generation by type, Pennsylvania						
2000	45.6%	N/A	0.2%	13.8%	40.4%	100%
2011	44.0%	0.3%	24.5%	8.6%	22.6%	100%

Notes: (a) (Non-Woody)

Source. Energy Information Administration

Exhibit 3-9. Total renewable electricity generation trends: Pennsylvania, nearby states and US

Billions of kilowatt hours

Year	MD	NJ	NY	OH	PA	U.S.
2000	2.6	1.4	27.8	1.2	5.0	356.5
2001	1.6	0.9	24.9	0.9	3.5	287.7
2002	2.2	0.9	26.9	0.6	4.3	343.4
2003	3.2	0.9	26.0	1.0	5.4	355.3
2004	3.1	0.8	25.9	1.2	5.4	351.5
2005	2.3	0.9	27.8	1.0	4.6	357.7
2006	2.7	1.0	29.9	1.1	5.3	385.8
2007	2.3	0.9	28.0	0.8	4.8	352.7
2008	2.6	0.9	30.0	1.0	5.4	380.9
2009	2.4	1.0	32.1	1.2	6.0	417.7
2010	2.2	0.9	30.3	1.1	6.6	427.4
2011	3.4	1.0	32.9	1.3	7.3	513.4

Indexed with 2000 = 100

Year	MD	NJ	NY	OH	PA	U.S.
2000	61.0	62.5	89.5	76.5	70.6	80.7
2001	85.6	62.3	96.6	52.0	85.1	96.3
2002	127.1	68.6	93.6	77.3	108.4	99.7
2003	121.4	61.2	93.2	94.1	108.2	98.6
2004	91.2	65.7	99.9	78.1	90.9	100.3
2005	107.0	69.1	107.7	88.6	105.9	108.2
2006	88.4	62.7	100.8	68.7	95.2	99.0
2007	101.4	67.5	108.1	82.1	106.6	106.9
2008	95.6	72.0	115.4	94.4	120.2	117.2
2009	87.8	63.0	109.0	91.8	131.0	119.9
2010	132.1	71.1	118.4	107.2	145.7	144.0
2011	61.0	62.5	89.5	76.5	70.6	80.7

Source. Energy Information Administration

Exhibit 3-10. Pennsylvania electricity generation capacity trends									
State total electric power industry net summer capacity, by energy source (MWs)									
	Fossil Fuels				Nuclear	Renewables	Pumped Storage	Other	Total
	Coal	Petroleum	Natural Gas	Other Gases					
2000	18,750	4,941	1,455	119	9,060	1,094	1,412	N/A	36,848
2001	18,578	4,811	2,515	106	9,130	1,193	1,345	N/A	37,678
2002	18,384	3,372	6,223	105	9,127	1,228	1,345	-	39,783
2003	18,137	5,030	7,083	110	9,175	1,326	1,507	-	42,368
2004	18,662	4,918	9,384	110	9,229	1,329	1,505	-	45,136
2005	18,569	4,604	9,400	110	9,195	1,423	1,505	-	44,897
2006	18,771	4,664	9,349	110	9,234	1,365	1,513	-	45,005
2007	18,581	4,660	9,410	100	9,305	1,529	1,521	-	45,106
2008	18,513	4,540	9,507	94	9,337	1,619	1,521	-	45,130
2009	18,539	4,533	9,491	101	9,455	1,971	1,521	-	45,611
2010	18,481	4,534	9,415	100	9,540	1,984	1,521	-	45,575
2011	18,068	4,325	10,055	100	9,642	2,106	1,521	-	45,817
2012	17,476	4,392	9,994	100	9,593	2,344	1,521	335	45,755

Exhibit 3-11. Distribution of generation capacity by fuel type									
2000	50.9%	13.4%	3.9%	0.3%	24.6%	3.0%	3.8%	N/A	100.0%
2012	38.2%	9.6%	21.8%	0.2%	21.0%	5.1%	3.3%	0.7%	100%
Sources: Energy Information Administration, PJM Interconnection									

Exhibit 3-13. Total net summer generation capacity: Pennsylvania, nearby states and US

Megawatts

Year	MD	NJ	NY	OH	PA	U.S.
2000	10,523	16,566	35,613	28,501	36,848	811,719
2001	11,930	16,082	35,653	29,553	37,678	848,254
2002	11,859	18,384	36,041	31,477	39,783	905,301
2003	12,472	18,647	36,696	34,060	42,368	948,446
2004	12,499	18,164	37,842	34,050	45,136	962,942
2005	12,503	17,536	39,122	33,870	44,897	978,020
2006	12,500	18,971	39,550	33,877	45,005	986,215
2007	12,486	18,352	39,121	33,755	45,106	994,888
2008	12,585	18,508	38,720	33,492	45,130	1,010,171
2009	12,482	18,499	39,671	33,539	45,611	1,025,400
2010	12,516	18,424	39,357	33,071	45,575	1,039,137

Indexed with 2000 = 100

Year	MD	NJ	NY	OH	PA	U.S.
2000	100	100	100	100	100	100
2001	113.4	97.1	100.1	103.7	102.3	104.5
2002	112.7	111.0	101.2	110.4	108.0	111.5
2003	118.5	112.6	103.0	119.5	115.0	116.8
2004	118.8	109.6	106.3	119.5	122.5	118.6
2005	118.8	105.9	109.9	118.8	121.8	120.5
2006	118.8	114.5	111.1	118.9	122.1	121.5
2007	118.7	110.8	109.9	118.4	122.4	122.6
2008	119.6	111.7	108.7	117.5	122.5	124.4
2009	118.6	111.7	111.4	117.7	123.8	126.3
2010	118.9	111.2	110.5	116.0	123.7	128.0

Source. Energy Information Administration

Exhibit 3-15. Electric power generation business establishments in Pennsylvania by county, 2012		
County	Plant Name(s)	First Year of Operation
Adams	Hamilton Generating Station	1971
	Hunterstown Generating Station	1971
	Mountain Generating Station	1972
	Orrtanna Generating Station	1971
	Tolna Generating Station	1972
Allegheny	Duquesne University Cogeneration Plant	1997
	Springdale Generating Station	1999
	Brunot Island Generating Station	1971
	Cheswick Generating Station	1970
	Allegheny Lock & Dam No. 9	1990
	Clairton USX Cogeneration Plant	1965
Armstrong	Allegheny Lock & Dam	1990
Beaver	AES Beaver Valley LLC	1988
	Bruce Mansfield Plant	1976
	Beaver Valley Power Station	1976
Berks	Pioneer Crossing Landfill Plant	2008
	Ontelaunee Energy Center	2002
	Corrstack Cogeneration Plant	2009
	Titus Generating Station	1951
Bucks	Fairless Energy LLC	2004
	Wheelabrator Falls Inc.	1994
Cambria	Colver Power Project	1995
	Ebensburg Power Co.	1991
	Allegheny Ridge Wind Farm	2007
	Cambria Cogen Company	1991
Carbon	Panther Creek Partners Energy Facility	1992
Clarion	Colmac Clarion Inc.	1993
Columbia	PPL Susquehanna LLC	1983
Dauphin	Harrisburg WTE Plant	2006
	Three Mile Island Nuclear Station	1974
	NRG Energy Paxton LLC	1986
Delaware	Delaware Valley Resource Recovery Facility	1991
	Liberty Electric Power LLC	2002
	Chester Cogeneration Plant	1986
	Marcus Hook Cogeneration Plant	1987
	Marcus Hook Energy Center	2004
Elk	Bradford Plant	1993
	Johnsonburg Mill Power Plant	1993
Erie	Erie Works Plant	1982
	North East Cogeneration Plant	1993
	LakeView Landfill	1996
Fayette	Fayette Energy Facility	2003
	Hatfield's Ferry Power Station	1969
	Lake Lynn Hydroelectric Plant	1926
Franklin	Chambersburg Power Plant	1967
	Mountain View Landfill	2003
Huntingdon	William F Matson Hydroelectric Plant	1988
Indiana	Keystone Generating Station	1967
	SW Jack Cogeneration Plant	1988
	Armstrong Energy LLC	2002
	Homer City Generation LP	1969
	Conemaugh Saltsburg	1989

Lackawanna	Archbald Power Station	1987
	Keystone Resource Recovery Plant	1994
Lancaster	Lancaster County Resource Recovery Plant	1991
	Muddy Run Hydroelectric Plant	1967
	PPL Holtwood LLC	1910
	Safe Harbor Hydroelectric Plant	1931
Lebanon	AES Ironwood LLC	2001
	Lebanon County Landfill Plant	2007
Lehigh	Allentown Generating Station	1967
	Fishbach Generating Station	1969
	Harrisburg Generating Station	1967
	Harwood Generating Station	1967
	Jenkins Generating Station	1967
	Lock Haven Generating Station	1969
	Suburban Generating Station	1970
	West Shore Generating Station	1969
	Williamsport Generating Station	1967
Luzerne	Bear Creek Wind Energy	2006
	Lakeside Hazelton LLC	1989
	Hunlock Creek Energy Center	2011
Lycoming	Koppers Montgomery Cogeneration Plant	1988
	Lycoming County Landfill	1993
Mercer	Grove City Plant	1985
Montgomery	Montenay Montgomery LP	1992
	Limerick Nuclear Generating Station	1986
	West Point Merck Plant	1987
	Pottstown Plant	1989
Montour	PPL Montour LLC	1971
Northampton	Bethlehem Energy Center	2002
	Bethlehem Renewable Energy	2010
	Northampton Generating Station	1995
	Blossburg Generating Station	1971
	Portland Generating Station	1958
	Shawnee Generating Station	1972
	Lower Mount Bethel Energy LLC	2004
	PPL Martins Creek LLC	1971
Northumberland	Northumberland Cogeneration Facility	1989
	Mount Carmel Cogeneration Inc.	1990
Philadelphia	Exelon Power Mid-Atlantic Peaking Division	1955
	Philadelphia Container Plant	Unknown
	Philadelphia Refinery Power Plant	1952
	Temple Univ. Standby Electric Generating Facility	1993
	Grays Ferry Power Plant	1997
Schuylkill	Locust Ridge Wind Farm	2007
	John B. Ritch Memorial Power Station	1988
	WPS Westwood Generation LLC	1988
	NEPCO-Northeastern Power Co.	1989
	St. Nicholas Cogeneration Plant	1989
	Wheelabrator Frackville Inc.	1988
	Northeastern Power Compnay	1989
Snyder	Sunbury Generation LP	1949
Somerset	Meyersdale Wind Energy	2003
Susquehanna	Waymart Wind Energy Center	2003
Tioga	Armenia Mountain Wind LLC	2012
Union	Bucknell Cogeneration Plant	1998
Venango	Scrubgrass Generating Plant	1993
	Handsome Lake Energy LLC	2001

Warren	Seneca Pumped Storage Plant	1969
Washington	Mitchell Generating Station	1949
Wayne	PPL Wallenpaupack LLC	1926
Westmoreland	Conemaugh Power Plant Seward Generating Station	1970 2004
Wyoming	Mehoopany Plant	1985
York	York Energy Center York County Resource Recovery Plant Peach Bottom Atomic Power Station York Haven Hydroelectric Plant Spring Grove Glatfelter Cogeneration Plant PPL Brunner Island LLC Modern Landfill York Solar Plant	2011 1989 1974 1905 1989 1961 1998 1989
Outside of PA	Piney Dam Hydroelectric Plant (New York)	
PA-Statewide		**119**
Source: Platts, 2013 UDI Who's Who at Electric Power Plants, 23rd Edition		

Pennsylvania Generation Facilities by Fuel Type, as of December 2012

Coal & Waste Coal					
Company Name	Plant	Fuel Type	Alt. Fuel Type	Tech. Type	MW
AES Corporation	Beaver Valley	Coal	None	ST/S	120
Consolidated Rail Corporation	Juniata Locomotive Shop	Coal		ST-H	4
Constellation Energy Group (10.6%)	Conemaugh Generating Station	Coal		ST	183.8
Constellation Energy Group (20.99%)	Keystone Generating Station	Coal		ST	363.4
Corona Power, LLC	Sunbury Generation LP	Coal	Oil	ST/GT/IC	462.5
Duquesne Conemaugh LLC (4.26%)	Conemaugh Generating Station	Coal	Gas/Oil	IC/ST	69
Duquesne Keystone LLC (2.97%)	Keystone Generating Station	Coal	Oil	IC/ST	50.82
Exelon Power Generation Co. LLC* (20.72%)	Conemaugh Generating Station	Coal		ST	352
Exelon Power Generation Co. LLC* (20.91%)	Keystone Generating Station	Coal		ST	357
FirstEnergy Corp.* eff 2/25/11	Hatfield's Ferry Power Station	Coal		ST	1710
FirstEnergy Corp.* eff 2/25/11	Mitchell Generating Station	Coal	Oil	ST	370
FirstEnergy Generation Corp.*	Bruce Mansfield Plant	Coal		ST	2490
General Electric Co.	Erie Works Plant	Coal		ST	36
GenOn Energy, Inc.*	Cheswick Generating Station	Coal	Diesel	ST	565
GenOn Energy, Inc.* (16%)	Conemaugh Power Plant	Coal	Oil	IC/ST	281
GenOn Energy, Inc.* (16.25%)	Keystone Generating Station	Coal	Oil	IC/ST	284
GenOn Energy, Inc.*	Portland Generating Station	Coal	Gas	GT/ST	570
(Expected deactivation 1/2015)					
(Expected deactivation 4/2015)					
GenOn Energy, Inc.*	Shawville Generating Station	Coal	Oil	ST	603
(Expected deactivation 4/2015)					
GenOn Energy, Inc.	Titus Generating Station	Coal	Gas	ST/GT	274
(Expected deactivation 4/2015)					
(Expected deactivation 6/2012)					
Keystone Power, LLC (4.2%)	Keystone Generating Station	Coal	Oil	IC/ST	71.86
Kimberly Clark Corp	Chester Cogeneration Plant	Coal	Coke	ST-S	59
Midwest Generation LLC (GE to assume)	Homer City (EME) Generation	Coal		ST	2012
NRG Energy* (3.7%)	Conemaugh Generating Station	Coal	Gas/Oil	IC/ST	65
NRG Energy* (3.7%)	Keystone Generating Station	Coal	Oil	IC/ST	65
PH Glatfelter Co.	Spring Grove Glatfelter Cogeneration Plant	Coal		ST-S	67.25
PPL Generation LLC*	PPL Brunner Island	Coal		ST	1490
PPL Generation LLC*	PPL Montour LLC	Coal		ST	1515
PPL Montour, LLC* (16.25%)	Conemaugh Generating Station	Coal	Gas/Oil	IC/ST	279
PPL Montour, LLC* (12.34%)	Keystone Generating Station	Coal	Oil	IC/ST	212
PSEG Fossil* (22.5%)	Conemaugh Power Plant	Coal		IC/ST	385
PSEG Fossil* (22.84%)	Keystone Generating Station	Coal	Oil	IC/ST	391
UGI Development Co.* (5.97%)	Conemaugh Generating Station	Coal	Gas/Oil	IC/ST	102
Weyerhaeuser Co (WEYCO)	Bradford (PA) Plant	Coal	Liq	ST	52
A/C Power-Colver Operations	Colver Power Project	Waste Coal		ST-S	76.5
(75% owned in 2011)					
American Consumer Industries Inc. (ACI)	Colmac Clarion Inc.	Waste Coal	None	ST	32
Babcock & Wilcox Partnership (ESI Energy, Inc.)	Ebensburg Power Co	Waste Coal		ST-S	48.5
Calypso Energy Holdings	Scrubgrass Generating Plant	Waste Coal		ST	83
Cogentrix Energy LLC*	Northhampton Generating Station	Waste Coal	Tires	ST-S	134
Constellation Power Inc.	Panther Creek Partners Energy Facility	Waste Coal		ST-S	95

(50% owner w/partners)					
Ebensburg Power Co.* (Partnership)	Ebensburg Power Co	Waste Coal		ST-S	48.5
Exelon Power Generation Co. LLC*	Colver Power Project	Waste Coal		ST-S	25.5
(25% in 2011)					
GenOn Energy, Inc.*	Seward Generating Station	Waste Coal		ST	525
Gilberton Power Co.	John B Rich Memorial Power Station	Waste Coal		ST-S	80
Integrys Energy Services, Inc.*	WPS Westwood Generation	Waste Coal		ST	30
IPR GDF Suez Energy Generation NA, Inc.*	NEPCO-Northeastern Power Co.	Waste Coal		ST	59
Mount Carmel Cogeneration, Inc.	Mount Carmel Cogeneration, Inc.	Waste Coal		ST-S	46.5
Northern Star Generation Services Co.	Cambria County Cogen	Waste Coal		ST-S	98
Schuylkill Energy Resources	St Nicholas Cogeneration Plant	Waste Coal		ST-S	100
Wheelabrator Technologies Inc. (WTI)	Wheelabrator Frackville Energy Co.	Waste Coal		ST-S	48

Oil, Gas & Natural Gas (excluding landfill gas)					
Company Name	Plant	Fuel Type	Alt. Fuel Type	Tech. Type	MW
United States Steel Corp.	Clairton USX B Plant	COG	Gas	GT/S/ST/S	219.75
AES Corporation	AES Ironwood LLC	Gas	Oil/WSTH	CC	771
(negotiating w/PPL for sale)					
Bucknell University	Bucknell Cogeneration Plant	Gas	Oil	GT/S	7
Calpine Corp.	Bethlehem Energy Center	Gas	WSTH	CC	1037
Chambersburg Borough Electric Dept.	Chambersburg Power Plant	Gas	Oil	IC	30.5
Constellation Power Group (CPG)	Handsome Lake Plant	Gas		SC	267.5
Dominion Generation (DEI)	Fairless Energy LLC	Gas		CC	1200
Duke Energy Ohio Inc.	Fayette County Energy Facility	Gas		CC	677
Duquesne University	Duquesne University Cogeneration Plant	Gas		GT/ST	4.75
Dynegy Midwest Generation Inc.	Ontelaunee Energy Center	Gas	WSTH	CCGT	545
EquiPower Resources Corp.	Liberty Electric Power LLC	Gas		CC	610
FirstEnergy Corp.* eff 2/25/11	Springdale, Units 1,2,3,4 & 5	Gas		CC/GT	638
GenOn Energy, Inc.*	Blossburg Plant (Mothball Pending)	Gas		GT	19
GenOn Energy, Inc.*	Hunterstown Generating Station	Gas	Diesel	CC	60
GenOn Energy, Inc.*	Hunterstown Generating Station CCGT	Gas		CC	810
GenOn Energy, Inc.*	Mountain Generating Station	Gas	Oil	GT	40
GenOn Energy, Inc.*	Warren Generating Station	Gas	Oil	GT	57
Indiana University of Pennsylvania*	SW Jack Cogeneration Plant	Gas	Oil	IC-H	24.4
IPR GDF SUEZ North America (ANP)*	Armstrong Energy LLC	Gas		GT	688
Lakeside Energy, LLC	Lakeside Hazelton LLC	Gas	Oil	GT	171.5
Merck & Co., Inc.	West Point (PA) Merck Plant	Gas	Oil	GT/ST	30.25
Morris Energy Group LLC (MEG)	York Solar Plant	Gas	Oil/WSTH	CC	52.2
NAES Corp	North East Cogeneration Plant	Gas	LPG/WSTH	CC	81.8
NextEra Energy Resources (formerly FPL)*	Marcus Hook Energy Center	Gas		CC	750
NRG Thermal, LLC	NRG Energy Paxton LLC	Gas	Oil	ST-S	12.6
PEI Power Corp.	Archbald Power Station	Gas	LGAS	GT/ST	79.2
PPL Generation LLC*	Lower Mt. Bethel Energy LLC	Gas		CC	623
Procter & Gamble	Mehoopany Plant	Gas		GT-S	53
Sapphire Power Partners, LLC eff. Oct. 2011	York Solar Plant	Gas		CC	52.2
Temple University	Temple Univ. Standby Electric Gen. Facility	Gas		IC-H	16
Veolia Energy North America, Inc.	Grays Ferry Power Plant	Gas		CC	174.6
Calpine Corp.	York Energy Center	Nat. Gas	Oil	CCG	565
Exelon Power Generation Co. LLC*	Eddystone Generating Station 3 & 4	Nat. Gas	Oil	ST	760

GenOn Energy, Inc.*	Brunot Island Generating Station	Nat. Gas	Oil	CC/GT	289
PPL Renewable Energy*	The Hill at Whitemarsh	Nat. Gas		GT/H	1.6
Exelon Power Generation Co. LLC*	Chester Peaking Plant	Oil		GT	39
Exelon Power Generation Co. LLC*	Croydon Peaking Plant	Oil		GT	391
Exelon Power Generation Co. LLC*	Delaware Peaking Plant	Oil		GT	56
Exelon Power Generation Co. LLC*	Delaware Peaking Plant	Oil		IC/Diesel	3
Exelon Power Generation Co. LLC*	Falls Twp. Peaking Station	Oil		GT	51
Exelon Power Generation Co. LLC*	Moser Peaking Station	Oil		GT	51
Exelon Power Generation Co. LLC*	Richmond Peaking Station	Oil		GT	96
Exelon Power Generation Co. LLC*	Schuylkill Generating Station	Oil		GT-S	166
Exelon Power Generation Co. LLC*	Schuylkill Peaking Station	Oil		GT	30
Exelon Power Generation Co. LLC*	Schuylkill Peaking Station	Oil		IC/Diesel	3
Exelon Power Generation Co. LLC*	Southwark Peaking Station	Oil		GT	52
General Electric Co.	Grove City Plant	Oil		GT	10.6
GenOn Energy, Inc.*	Hamilton Generating Station	Oil		GT	20
GenOn Energy, Inc.*	Orrtanna Generating Station	Oil		GT	20
GenOn Energy, Inc.*	Shawnee Generating Station	Oil		GT	20
GenOn Energy, Inc.*	Tolna Station	Oil		GT	39
PPL Generation LLC*	Allentown Generating Station	Oil		GT	64
PPL Generation LLC*	Fishbach Generating Station	Oil		GT	37.2
PPL Generation LLC*	Harrisburg Generating Station	Oil		GT	64
PPL Generation LLC*	Harwood (PA) Generation Station	Oil		GT	32
PPL Generation LLC*	Jenkins Generating Station	Oil		GT	32
PPL Generation LLC*	Lock Haven Generating Station	Oil		GT	18.6
PPL Generation LLC*	PPL Martins Creek	Oil	Natural Gas	GT/ST	1690
PPL Generation LLC*	Suburban Generation Station c/o Martins Creek	Oil		GT	29
PPL Generation LLC*	West Shore Generating Station	Oil		GT	37.2
PPL Generation LLC*	Williamsport Generating Station	Oil		GT	32
Rock-Tenn Co.	Philadelphia Container Plant	Oil		ST/S	10
Rohm and Haas Co.	Bristol	Oil		ST	1.5
Sunoco, Inc.	Philadelphia Refinery Power Plant	RGAS		ST/S	30

Nuclear

Company Name	Plant	Fuel Type	Alt. Fuel Type	Tech. Type	MW
Exelon Nuclear*	Limerick Nuclear Gen. Station, Units 1&2	Nuclear		ST-BWR	2345
Exelon Nuclear*	Three Mile Island	Nuclear		ST-PWR	837
Exelon Nuclear* (50%)	Peach Bottom Atomic Power St., Units 2&3	Nuclear		ST-BWR	1182
FirstEnergy Nuclear Operating Co.*	Beaver Valley Power Station	Nuclear		ST-PWR	1815
PSEG Power (50%)	Peach Bottom Atomic Power St., Units 2&3	Nuclear		ST-BWR	1182
PPL Generation LLC*	PPL Susquehanna LLC	Nuclear-BWR		ST	2528

Renewables

Company Name/Operator Name	Plant	Fuel Type	Alt. Fuel Type	Tech. Type	MW
Access Energy LLC	Pioneer Crossing Landfill Plant	LGAS		IC	6.4
Lycoming County Resource Management Services	Lycoming County Landfill	LGAS		IC/H	1
PPL Renewable Energy*	Cumberland County Landfill	LGAS		IC	6.4

PPL Renewable Energy*	Frey Farm Landfill	LGAS		IC	3.2
PPL Renewable Energy*	Greater Lebanon Refuse Authority (2007)	LGAS		IC	3.2
PPL Renewable Energy*	Northern Tier Landfill	LGAS		IC	1.6
Republic Services, Inc.	Modern Landfill	LGAS	None	IC	9,00
WM Renewable Energy LLC (WM)	Lake View Landfill	LGAS	None	IC	6.1
UGI Energy Services	Crayola Solar Park	Sun		PV	1.9
Allegheny Electric Cooperative*	William F Matson Hydroelectric Plant	Water		HY	21.7
Brookfield Renewable Power, Inc.	Piney Dam (PA) Hydroelectric Plant	Water		HY	28.8
Constellation Generation Group*	Safe Harbor Hydroelectric Plant	Water		HY	417.5
Exelon Power Generation Co. LLC*	Muddy Run Hydroelectric Plant	Water		HY	800
FirstEnergy Corp.*	Allegheny Lock & Dam 5 & 6	Water		HY	13
FirstEnergy Corp.* eff 2/25/11	Lake Lynn Hydroelectric Project	Water		HY	52
FirstEnergy Generation Corp.*	Seneca Pumped Storage Plant	Water		HY	469
LS Power purchased from PPL 3/2011*	Safe Harbor Hydroelectric Plant (33.3% owned)	Water		HY	140
Olympus Power LLC/York Haven Power CO. LLC	York Haven Hydro Station	Water	None	HY	19.6
Pennsylvania Renewable Resources Assoc.	Conemaugh Saltsburg	Water		HY	15
PPL Generation LLC*	PPL Holtwood, LLC	Water		HY	109
PPL Generation LLC*	PPL Wallenpaupack LLC	Water		HY	40
Sithe Global LLC	Allegheny Lock & Dam No. 8	Water		HY	13
Sithe Global LLC	Allegheny Lock & Dam No. 9	Water		HY	17.4
Hydro Development Group Inc.	Beaver Valley Patterson Dam	Water		HY	1.2
American Project Develop Corp	Oakland Dam Hydroelectric	Water		HY	1.5
Beaver Falls Municipal Auth	Townsend Hydro	Water		HY	5.28
American Project Develop Corp	Warrior Ridge Hydroelectric	Water		HY	2.8
D/R Hydro Co	Yough Hydro Power	Water		HY	12.2
AES Wind Generation	Armenia Mountain	Wind		WTG	100.5
Babcock & Brown Wind Partners*	Allegheny Ridge Wind Farm	Wind		WTG	80
Bear Creek Wind Power Project Partners*	Bear Creek Wind Farm	Wind		WTG	24
Duke Energy	North Allegheny Wind Farm	Wind		WTG	70
E.On Climate and Renewables	Stony Creek Wind Farm	Wind		WTG	64.8
Edison Mission Group	Forward Wind Farm	Wind		WTG	29.4
Edison Mission Group	Lookout Windpower Wind Farm	Wind		WTG	37.8
EverPower Renewables	Highland Wind Project	Wind		WTG	62.5
PPM Atlantic Renewable/Iberdrola Renewables, LLC	Casselman Wind Project	Wind		WTG	34.5
Iberdrola Renewables, LLC	Locust Ridge II	Wind		WTG	102
Iberdrola Renewables, LLC	Locust Ridge Wind Farm	Wind		WTG	26
NextEra Energy Resources (formerly FPL)*	Green Mountain Wind Energy Center	Wind		WTG	10.4
NextEra Energy Resources (formerly FPL)*	Meyersdale Wind Power Project	Wind		WTG	30
NextEra Energy Resources (formerly FPL)*	Mill Run Wind	Wind		WTG	15
NextEra Energy Resources (formerly FPL)*	Somerset Wind Farm	Wind		WTG	9
NextEra Energy Resources (formerly FPL)*	Waymart Wind Farm	Wind		WTG	64.5
Pennsylvania Wind Energy	Humboldt Industrial Park	Wind		WTG	0.13
Gamesa Technology Corp. and enXco, an EDF Energies Nouvelles Company	Chestnut Flats	Wind		WTG	38
EverPower Renewables	Highland North	Wind		WTG	80
Gamesa	Sandy Ridge I	Wind		WTG	18
Gamesa	Sandy Ridge II	Wind		WTG	32
PPL Renewable Energy, LLC/ Lancaster Solid Waste Management Authority	Turkey Hill Dairy	Wind		WTG	3.2

Laurel Hill Wind Energy, subsidiary of Duke Energy	Laurel Hill	Wind		WTG	69
BP Wind Energy and Sempra U.S. Gas & Power	Mehoopany	Wind		WTG	144
EverPower Wind Holdings	Patton	Wind		WTG	30
Iberdrola/PPM Atlantic Renewable	South Chestnut	Wind		WTG	46
EverPower Wind Holdings	Twin Ridges Wind Farm	Wind		WTG	139.4
Evergreen Community Power LLC	Corrstack Cogeneration Plant	Wood		ST-S	33

Other

Company Name	Plant	Fuel Type	Alt. Fuel Type	Tech. Type	MW
Covanta Energy Corp.	Montenay Montgomery LP	Other		ST	32.13
Covanta Energy Corp.	York County Resource Recovery Plant	Other		ST	36.5
Covanta Energy Corp. for Harrisburg Authority	Harrisburg WTE Plant	Other	Gas	ST-S	24.1
Covanta Energy Corporation	Covanta Plymouth Renewable Energy Ltd.	Other		ST	32.13
Covanta Energy Corporation	Delaware Valley Resource Recovery Facility	Other		ST-S	90
Covanta Energy Corporation	Lancaster County Resource Recovery Facility	Other		ST	35.7
Exelon Power Generation Co. LLC*	Exelon-Conergy Solar Energy Center	Other		PV	3
Exelon Power Generation Co. LLC*	Fairless Hills Generating (Peaking)	Other		ST-S	60
Exelon Power Generation Co. LLC*	Pennsbury Peaking Station	Other		GT	6
GlaxoSmith Kline	GSK York RDC Solar Facility	Other		PV	3
Ingenco	Mountain View Landfill	Other	Oil	IC	16
IPR GDF Suez Energy Generation NA, Inc.*	Northumberland Cogeneration Facility	Other	NG	GT	20
Koppers, Inc.	Koppers Montgomery Cogeneration Plant	Other		ST-S	10
NextEra Energy Resources (formerly FPL)*	Marcus Hook Cogen Power Plant	Other		GT-S	50
PPL Renewable Energy*/Chrin Brothers, Inc.	Glendon Green Energy Park - Chrin Plant	Other		IC	3.2
UGI Energy Services	Broad Mountain Power Station	Other		IC	11
Wheelabrator Technologies Inc. (WTI)	Wheelabrator Falls, Inc.	Other		ST	53
WM Renewable Energy LLC (WM)	Pottstown Plant	Other		GT	6.4

*=verified data					
Sources: Electric Power Generation Association, Pennsylvania Generation Facilities, Revised 4/12 Pennsylvania Department of Environmental Protection, Revised 2013					
Source link: http://www.epga.org/documents/pagenfac.pdf					

Terms and Abbreviations	
CC	(Combined-cycle); A generating installation in which the exhaust heat from a gas or combustion turbine produces steam to power a steam turbine.
CC/GT	Combined Cycle Gas Turbine plant
CCSS	Combined-cycle single shaft
COG	Coke oven gas
FC	Fuel Cell
GT	(Gas turbine); A generating installation with a turbine in which combustion chambers (fired directly by oil or gas) produce a hot gas which drives the turbine rotor.
GT/C	Gas or combustion turbine in combined cycle GT/H Gas or combustion turbine with heat recovery
GT/H	(Gas turbine w/heat recovery); A generating installation with a gas turbine which has heat recovery.
GT/S	(Gas turbine w/steam sendout); A generating installation with a gas turbine which has steam-sendout.
GT/T	Gas or combustion turbine in topping configuration with existing conventional boiler and T/G
HY	(Hydroelectric); A hydroelectric generating installation (usually conventional).

HY-P	(Hydroelectric, pump storage); A hydroelectric generating installation in which, during off peak hours, the turbines are generator-driven to pump water from a lower to a higher reservoir. At peak times, the water stored in the upper reservoir is released through the turbines to generate electricity.
IC	(Internal combustion); An engine-driven generating installation where the internal combustion of the fuel acts directly to produce mechanical power to drive the generator.
IC/H	(Internal combustion engine w/heat recovery); An engine-driven generating installation with heat recovery where the internal combustion of the fuel acts directly to produce mechanical power to drive the generator.
LGAS	Landfill gas
LIQ	Pulping liquor (black liquor)
LPG	Liquefied petroleum gas (usually butane or propane)
NG	Natural Gas
ORC	(Organic Rankine-cycle); A generating installation with an organic Rankine-cycle (vapor) turbine or organic Rankine-cycle energy converter.
PV	(Photovoltaic); A generating installation powered by photovoltaic cells.
RGAS	Refinery off-gas
SUN	Solar power
ST	(Steam, fossil-fired); A generating installation with a steam turbine-generator set powered by fossil fuel.
ST/H	(Steam, fossil-fired w/heat recovery); A generating installation with a steam turbine-generator set with heat recovery.
ST/S	(Steam, fossil-fired w/steam sendout); A generating installation with a steam turbine-generator set with steam sendout.
ST; UR	(Steam, nuclear-powered); A generating installation with a steam turbine-generator set powered by a nuclear reactor (BWR, PWR, HTGR or CANDU).
TEX	(Turbo expander); A generating installation powered by a turbo expander/gas expander.
WSTH	A generating installation with a wind turbine generator.
WTG	WTG (Wind turbine generator)
Sources: 1. http://www.platts.com/im.platts.content/downloads/udi/eppd/eppddir.pdf 2. Electric Power Outlook for Pennsylvania, PUC.	

Operating Commercial and Institutional Solar Thermal Facilities in Pennsylvania, as of December 2012

Entity Name	County	Annual Electricity Saved
Housing Authority of Luzerne County	Luzerne	35,922 kWh
Mount Carmel Area School District	Northumberland	225,239 kWh
Conservation Consultants Inc.	Allegheny	N/A
Ross Hill Retirement Residence	Allegheny	N/A
Lancaster County Career & Technology Center	Lancaster	14.7 MWh
Fulton County Conservation District	Fulton	N/A
Longwood Manor Apartments	Philadelphia	N/A
Adams County Correctional Facility	Adams	N/A
Pittsburgh Truck House (firehouse) No. 34	Allegheny	N/A
Source: Pennsylvania Department of Environmental Protection, Revised 2013		

Operating Farm and Food Processing Anaerobic Digesters and Gasifiers in Pennsylvania, As of December 2012

Farm Name	County	Biogas end-use	Rated Capacity (kW)
Beaver Ridge Farm	Perry	Electricity and hot water	130
Bortnick Dairy	Crawford	Electricity and digester heating	450
Brookside Dairy	Indiana	Electricity and hot water	107
Brubaker Farms	Lancaster	Electricity and hot water	225

Dairy Farmers of America	Mercer	N/A	N/A
David High	Schuylkill	Electricity and hot water	22
Dovan Farms	Somerset	Electricity and hot water	160
Fairview Swiss Cheese	Mercer	Electricity and boiler fuel	300
Four Winds Farm	Potter	Electricity and hot water	130
Furman Foods	Northumberland	Electricity	300
Hillcrest Saylors Farm	Somerset	Electricity and hot water	260
Ideal Family Farms	Snyder	Electricity and barn heaters	180
Kish-View Farms	Mifflin	Electricity and hot water	100
Klines Services	Lancaster	Electricity	710
Landyshade Farms	Lancaster	Electricity and hot water	180
Mains Farm	Cumberland	Electricity and hot water	90
Mason-Dixon Farms	Adams	Electricity and hot water	600
Mathis Farm	Centre	Electricity and hot water	25
Mor-Dale Farms	Lebanon	Electricity	100
Oak Hill Farm	Chester	Electricity	40
Oregon Dairy Farm	Lancaster	Electricity and hot water	65
Penn England Farm	Blair	Electricity and hot water	130
Pennwoods Farms	Somerset	Electricity	180
Pine Hurst Acres	Northumberland	Electricity	47
Reinford Farm	Juniata	Electricity and hot water	130
Rocky Knoll Swine Farm	Lancaster	Electricity and hot water	130
S & A Kreider Farms	Lancaster	Electricity	225
Schrack Farms	Clinton	Electricity and hot water	200
Sun Re Cheese	Northumberland	Process Steam	5,260 MMBtu/Hr
Wanner's Pride-N-Joy Farm	Lancaster	Electricity and hot water	160
Meadow Springs Farm	Lancaster	*Unclear if this is operating	44
Source: Pennsylvania Department of Environmental Protection, Revised 2013			

Appendix 4: Imports & Exports

Exhibit 4-1. Total energy production and consumption: 2000 – 2010, Pennsylvania (trillions of BTU)			
Year	Production	Consumption	Balance
2000	3,002	3,928	-926
2001	2,995	3,845	-850
2002	2,906	3,905	-999
2003	2,847	3,934	-1,087
2004	3,092	3,994	-902
2005	3,067	4,022	-955
2006	3,002	3,895	-892
2007	3,023	3,973	-950
2008	3,048	3,883	-835
2009	2,888	3,638	-750
2010	3,206	3,759	-553
Sources: Energy Information Administration, Pennsylvania Department of Environmental Protection			

Exhibit 4-2. Total energy production and consumption balance: Pennsylvania, nearby states and US

Trillion BTU

Year	MD	NJ	NY	OH	PA	U.S.
2000	-1,135	-2,135	-3,334	-3,274	-925.7	-27,507
2001	-1,132	-2,103	-3,145	-2,992	-849.9	-24,437
2002	-1,224	-2,131	-3,156	-3,089	-999.1	-26,930
2003	-1,234	-2,177	-3,283	-3,139	-1,086.9	-27,966
2004	-1,215	-2,244	-3,460	-3,098	-902.4	-29,951
2005	-1,262	-2,314	-3,279	-3,081	-955.3	-30,802
2006	-1,164	-2,180	-2,921	-2,965	-892.4	-28,929
2007	-1,276	-2,322	-3,075	-3,156	-949.9	-30,073
2008	-1,225	-2,206	-2,967	-2,954	-835.3	-26,345
2009	-1,220	-1,983	-2,839	-2,644	-750.3	-21,834
2010	-1,235	-2,082	-2,853	-2,798	-553.1	-23,113

Indexed with 2000 = 100

Year	MD	NJ	NY	OH	PA	U.S.
2000	100	100	100	100	100.0	100
2001	99.8	98.5	94.3	91.4	91.8	88.8
2002	107.9	99.8	94.7	94.3	107.9	97.9
2003	108.7	102.0	98.5	95.9	117.4	101.7
2004	107.1	105.1	103.8	94.6	97.5	108.9
2005	111.2	108.4	98.4	94.1	103.2	112.0
2006	102.6	102.1	87.6	90.6	96.4	105.2
2007	112.5	108.7	92.2	96.4	102.6	109.3
2008	107.9	103.3	89.0	90.2	90.2	95.8
2009	107.5	92.9	85.2	80.8	81.1	79.4
2010	108.8	97.5	85.6	85.5	59.8	84.0
Sources: Energy Information Administration, Pennsylvania Department of Environmental Protection						

Exhibit 4-3. Natural gas production and consumption: 2000 – 2017, Pennsylvania (trillions of BTU)			
Year	Production	Consumption	Balance
2000	156	727	-571
2001	139	669	-530
2002	165	701	-536
2003	167	718	-550
2004	206	723	-517
2005	177	719	-543
2006	184	685	-501
2007	191	780	-590
2008	208	778	-571
2009	286	840	-553
2010	591	889	-298
2011	751	918	-167
2012	912	964	-52
2013	944	938	6
2014	1,018	947	72
2015	1,093	950	143
2016	1,164	953	211
2017	1,242	953	289
Source: Energy Information Administration			

Exhibit 4-4. Natural gas production and consumption: 2000 – 2010, Pennsylvania (million cubic feet)			
Year	Production	Consumption	Balance
2000	150,000	702,883	-552,883
2001	130,853	634,794	-503,941
2002	157,800	675,583	-517,783
2003	159,827	689,992	-530,165
2004	197,217	696,175	-498,958
2005	168,501	691,591	-523,090
2006	175,950	659,754	-483,804
2007	182,277	752,401	-570,124
2008	198,295	749,883	-551,588
2009	273,869	809,706	-535,837
2010	572,902	859,939	-287,037
Source: Energy Information Administration			

Exhibit 4-5. Natural Gas production and consumption balance: Pennsylvania, nearby states and US

Trillion BTU

Year	MD	NJ	NY	OH	PA	U.S.
2000	-219.0	-617.9	-1,260.6	-817.3	-571.0	-1,436.0
2001	-184.8	-573.0	-1,176.3	-732.4	-529.9	-108.2
2002	-203.5	-617.1	-1,189.6	-755.3	-535.9	-1,564.2
2003	-204.3	-635.7	-1,094.2	-780.8	-550.1	-830.9
2004	-201.8	-644.5	-1,079.4	-767.8	-517.1	-1,321.6
2005	-211.8	-625.4	-1,050.6	-773.7	-542.6	-1,613.9
2006	-189.1	-566.7	-1,063.0	-681.2	-500.6	-787.8
2007	-208.4	-640.2	-1,158.1	-744.2	-589.5	-1,430.1
2008	-203.1	-634.7	-1,153.8	-735.2	-570.7	-689.2
2009	-203.6	-638.3	-1,120.8	-678.3	-553.2	333.3
2010	-213.7	-670.0	-1,187.4	-728.7	-298.0	384.0

Indexed with 2000 = 100

Year	MD	NJ	NY	OH	PA	U.S.
2000	100	100	100	100	100	100
2001	84.4	92.7	93.3	89.6	92.8	7.5
2002	92.9	99.9	94.4	92.4	93.8	108.9
2003	93.3	102.9	86.8	95.5	96.3	57.9
2004	92.1	104.3	85.6	93.9	90.6	92.0
2005	96.7	101.2	83.3	94.7	95.0	112.4
2006	86.4	91.7	84.3	83.4	87.7	54.9
2007	95.2	103.6	91.9	91.1	103.2	99.6
2008	92.7	102.7	91.5	90.0	99.9	48.0
2009	93.0	103.3	88.9	83.0	96.9	-23.2
2010	97.6	108.4	94.2	89.2	52.2	-26.7

Source. Energy Information Administration

Exhibit 4-6. Coal production and consumption: 2000 – 2017, Pennsylvania (trillions of BTU)			
Year	Production	Consumption	Balance
2000	1,954	1,508	446
2001	1,980	1,392	588
2002	1,837	1,457	380
2003	1,780	1,462	318
2004	1,953	1,474	479
2005	1,967	1,491	476
2006	1,904	1,499	405
2007	1,895	1,492	403
2008	1,882	1,421	461
2009	1,653	1,224	429
2010	1,640	1,311	329
2011	1,680	1,455	225
2012	1,565	1,503	62
2013	1,680	1,390	290
2014	1,478	1,390	88
2015	1,478	1,338	140
2016	1,416	1,266	150
2017	1,421	1,204	217
Sources: Energy Information Administration, Pennsylvania Department of Environmental Protection, 2011 Annual Historical Report			

Exhibit 4-7. Coal production and consumption: 2000 – 2017, Pennsylvania (thousand short tons)			
Year	Production	Consumption	Balance
2000	79,028	63,516	15,512
2001	80,093	60,161	19,932
2002	74,308	60,583	13,725
2003	71,989	61,992	9,997
2004	78,984	62,797	16,187
2005	79,543	65,044	14,499
2006	77,001	66,155	10,846
2007	76,650	65,693	10,957
2008	76,124	63,333	12,791
2009	66,850	55,063	11,787
2010	66,341	58,581	7,760
2011	67,930	53,044	14,886
2012	63,290	53,070	10,220
2013	67,930	53,097	14,833
2014	59,763	53,123	6,640
2015	59,763	53,149	6,613
2016	57,248	53,176	4,072
2017	57,479	53,202	4,277
Sources: Energy Information Administration, Pennsylvania Department of Environmental Protection, 2011 Annual Historical Report			

Exhibit 4-8. Coal production and consumption balance: Pennsylvania, nearby states and US

Trillion BTU

Year	MD	NJ	NY	OH	PA	U.S.
2000	-201.6	-114.7	-330.8	-900.2	446.0	19.6
2001	-207.2	-112.2	-307.0	-763.9	588.3	1,681.6
2002	-200.2	-104.8	-280.6	-889.0	380.0	827.0
2003	-205.0	-106.9	-286.2	-904.1	318.1	-269.0
2004	-198.1	-112.7	-276.5	-822.7	478.7	356.1
2005	-202.6	-125.3	-256.9	-874.6	476.0	388.2
2006	-202.5	-116.1	-256.3	-892.9	404.7	1,198.3
2007	-274.2	-111.8	-258.5	-908.1	403.4	587.5
2008	-243.7	-97.7	-229.0	-800.0	461.2	1,321.5
2009	-213.4	-59.6	-156.0	-597.1	429.0	1,996.6
2010	-207.3	-72.0	-167.1	-710.5	329.5	962.2

Indexed with 2000 = 100

Year	MD	NJ	NY	OH	PA	U.S.
2000	100.0	100.0	100.0	100.0	100.0	100.0
2001	102.8	97.8	92.8	84.9	131.9	8,589.1
2002	99.3	91.4	84.8	98.8	85.2	4,223.9
2003	101.7	93.1	86.5	100.4	71.3	-1,374.0
2004	98.3	98.2	83.6	91.4	107.3	1,818.9
2005	100.5	109.2	77.6	97.2	106.7	1,982.8
2006	100.5	101.2	77.5	99.2	90.7	6,120.6
2007	136.0	97.4	78.1	100.9	90.4	3,000.9
2008	120.9	85.1	69.2	88.9	103.4	6,750.0
2009	105.9	51.9	47.1	66.3	96.2	10,198.0
2010	102.8	62.7	50.5	78.9	73.9	4,914.8

Sources. Energy Information Administration, Pennsylvania Department of Environmental Protection, 2011 Annual Historical Report

Exhibit 4-9. Electricity production and consumption: 2000 – 2017, Pennsylvania (trillions of BTU)			
Year	Production	Consumption	Balance
2000	202	457	-255
2001	197	462	-265
2002	204	477	-273
2003	206	479	-273
2004	215	490	-275
2005	218	506	-288
2006	219	499	-280
2007	226	517	-291
2008	222	513	-291
2009	219	490	-271
2010	230	508	-279
2011	228	508	-280
2012	229	504	-275
2013	230	498	-267
2014	231	500	-269
2015	234	501	-267
2016	235	500	-265
2017	231	500	-269
Source: Energy Information Administration			

Exhibit 4-10. Total electricity production and consumption in Pennsylvania: 2000 - 2010 (billions of kilowatt hours)			
	Production	Consumption	Balance
2000	201.7	133.8	67.8
2001	196.6	135.3	61.3
2002	204.3	139.8	64.5
2003	206.3	140.4	66.0
2004	214.7	143.5	71.2
2005	218.1	148.3	69.8
2006	218.8	146.2	72.7
2007	226.1	151.6	74.5
2008	222.4	150.4	71.9
2009	219.5	143.7	75.7
2010	229.8	149.0	80.8
Source. Energy Information Administration			

Exhibit 4-11. Electricity production and consumption balance: Pennsylvania, nearby states and US

Million megawatt hours

Year	MD	NJ	NY	OH	PA	U.S.
2000	-9.5	-11.9	-3.9	-16.1	67.8	380.7
2001	-12.6	-13.8	-0.3	-13.5	61.3	342.2
2002	-20.1	-13.0	-7.8	-6.3	64.5	393.0
2003	-19.0	-19.0	-6.4	-5.6	66.0	389.4
2004	-14.8	-21.7	-7.1	-5.9	71.2	423.1
2005	-15.7	-21.3	-3.3	-3.2	69.8	394.5
2006	-14.2	-19.0	0.0	2.0	72.7	394.8
2007	-15.2	-19.3	-2.3	-6.6	74.5	392.2
2008	-16.0	-16.8	-3.7	-6.0	71.9	386.4
2009	-18.8	-14.0	-6.9	-10.2	75.7	353.5
2010	-21.7	-13.5	-7.7	-10.5	80.8	370.6

Indexed with 2000 = 100

Year	MD	NJ	NY	OH	PA	U.S.
2000	100	100	100	100	100	100
2001	131.9	115.7	6.7	83.9	90.4	89.9
2002	210.9	109.6	198.8	39.3	95.1	103.2
2003	199.5	159.6	162.2	34.7	97.3	102.3
2004	155.7	182.6	180.3	36.4	104.9	111.1
2005	164.7	179.5	82.6	19.8	102.9	103.6
2006	149.1	159.6	-0.7	-12.4	107.1	103.7
2007	159.4	162.0	58.2	41.0	109.8	103.0
2008	167.5	141.7	94.5	37.0	106.1	101.5
2009	197.4	117.5	174.4	63.3	111.7	92.8
2010	227.9	113.5	194.1	65.4	119.1	97.3

Source. Energy Information Administration

Exhibit 4-12. All other energy production and consumption: 2000 – 2010, Pennsylvania (trillions of BTU)			
Year	Production	Consumption	Balance
2000	202	1,235	-1,034
2001	203	1,322	-1,119
2002	205	1,270	-1,065
2003	194	1,275	-1,081
2004	199	1,307	-1,108
2005	177	1,306	-1,129
2006	166	1,212	-1,046
2007	164	1,183	-1,020
2008	197	1,170	-973
2009	198	1,084	-886
2010	188	1,050	-862
2011	-2,995	883	-3,878
2012	-3,060	859	-3,918
2013	-3,195	927	-4,122
2014	-3,095	938	-4,033
2015	-3,179	979	-4,159
2016	-3,201	1,040	-4,241
2017	-3,271	1,061	-4,332
Source: Energy Information Administration			

Appendix 5: Energy Efficiency, Conservation and Innovation

All data already in tabular form in the body of the report.

Appendix 6: Energy and Energy-related Infrastructure and Industry

Exhibit 6-3. High-voltage electrical transmission lines in Pennsylvania
Description: Electric Transmission Lines-Electric lines with voltage of 345 kV or more.
Map Source: Ventyx, Velocity Suite. Released: January 2009. Accessed through EIA at: http://www.eia.gov/beta/state/notes-sources.cfm?sid=PA

Exhibit 6-4. Miles of large interstate/intrastate pipeline in Pennsylvania					
	2008	2009	2010	2011	2012
Additions		14	32	199	232
Total miles	8,680	8,694	8,726	8,926	9,158
Source. Energy Information Administration					

Exhibit 6-5. Projections for mileage of gathering pipelines in Pennsylvania			
Year	Low	Medium	High
2010	2000	2000	2000
2011	2500	2825	3250
2012	3000	3650	4500
2013	3500	4475	5750
2014	4000	5300	7000
2015	4500	6125	8250
2016	5000	6950	9500
2017	5500	7775	10750
Source. The Nature Conservancy			

Exhibit 6-6. Trends in pipeline capacity: Pennsylvania vs. Northeast (billions of cubic feet/day)						
Year	PA			Northeast		
	Total outflow capacity	Total inflow capacity	Net outflow capacity	Total outflow capacity	Total inflow capacity	Net outflow capacity
2000	11.6	11.9	-0.3	2.7	13.6	-10.9
2001	12.3	11.9	0.4	2.8	13.8	-11.0
2002	12.5	12.5	0.0	2.8	14.2	-11.4
2003	12.5	12.5	0.0	3.3	14.2	-10.9
2004	12.7	12.7	0.0	3.3	14.5	-11.2
2005	12.7	12.7	0.0	3.3	14.5	-11.2
2006	13.1	12.8	0.3	3.3	14.5	-11.2
2007	13.4	12.8	0.7	3.3	14.7	-11.4
2008	13.6	13.6	0.0	3.5	15.4	-11.9
2009	13.7	13.8	0.0	3.5	15.6	-12.1
2010	14.0	13.8	0.2	3.5	15.7	-12.2
2011	15.0	13.8	1.2	3.5	15.9	-12.4
Source. Energy Information Administration						

Exhibit 6-8. Pennsylvania pipelines and other natural gas and oil facilities
Description: Natural Gas Flow-Natural gas transportation routes that have a capacity of more than 100 million cubic feet per day. Capacities determined at State borders. Note: Arrows indicate the net direction of gas flow.
Map Sources: EIA, Geographic Information System (GasTran). Last Modified: September 2009. Unpublished; EIA, State to State Natural Gas Pipeline Capacities and Flows (spreadsheet). Released: March 1, 2009. Accessed through EIA at: http://www.eia.gov/beta/state/notes-sources.cfm?sid=PA

Exhibit 6-12. Trends in energy infrastructure construction jobs: Pennsylvania vs. US (index 2003 = 100)				
	PA		U.S.	
	Oil & Gas	Power	Oil & Gas	Power
2003	100	100	100	100
2004	116	192	98	92
2005	73	99	102	87
2006	66	107	119	98
2007	66	120	143	102
2008	158	134	185	104
2009	176	139	169	102
2010	184	137	149	98
Source. U.S. Census Bureau				

Interstate Pipeline Projects, FERC Authority

Last Updated Date	Project Name	Pipeline Operator Name	Project Type	Status	Year In Service Date	State(s)	Miles	Additional Capacity (MMcf/d)	Docket Number
7/30/12	Sunrise Project	Equitrans	New Pipeline	Completed *7/19/12	2012	PA,WV	50	313.56	CP11-68
7/16/12	Inergy Marc I Hub Line Project	Inergy Midstream, LLC	Expansion	Construction	2012	PA	43	555	CP10-480
7/16/12	Philadelphia Lateral Expansion Project	Texas Eastern Transmission	Expansion	Construction	2012	PA		27	CP11-508
7/10/12	Ellisburg to Craigs Project	Dominion Transmission	Lateral	Construction	2012	PA		150	CP11-41
7/10/12	TETCO TEAM 2012 Expansion	Texas Eastern Transmission	Expansion	Construction	2012	PA	17.3	200	CP11-67
7/16/12	Northeast Supply Diversification Project	Tennessee Gas Pipeline Co	Expansion	Construction	2012	PA,NY	7	250	CP11-30
7/16/12	Station 230C Project	Tennessee Gas Pipeline Co	Expansion	Construction	2012	PA,NY		320	CP11-133
7/16/12	Line N 2012 Expansion	National Fuel Gas Supply Corp	Expansion	Construction	2012	PA	4.85	150	CP11-512
7/16/12	Appalachian Gateway Project	Dominion Transmission	New Pipeline	Construction	2012	WV,PA	110	484.26	CP10-448
7/16/12	Northeast Expansion Project	Dominion Transmission	Expansion	Construction	2012	PA		200	CP11-39
7/16/12	Northern Access Expansion Project	National Fuel Gas Supply Corp	Expansion	Construction	2012	PA,NY		320	CP11-128
4/6/12	TETCO TEAM 2014 Expansion	Texas Eastern Transmission	Expansion	Pre-filed	2014	PA		1400	PF12-19
4/2/12	Sabinsville to Morrisville Project	Dominion Transportation Inc.	Expansion	Applied	2013	PA	3.6	92	CP12-20
11/21/11	Tioga Area Expansion Project	Dominion Transmission	Expansion	Applied	2013	PA	15	270	CP12-19
3/27/12	Northeast Supply Link	Transcontinental Gas Pipe Line	Lateral	Applied	2013	PA	13	250	CP12-30
12/14/11	Northeast Supply Link Project	Transcontinental Gas Pipe Line	Expansion	Applied	2013	PA,NJ, NY	12.5	250	PF11-4
10/7/11	MPP Pipeline Project/300 Line Expansion Project expansion	Tennessee Gas Pipeline Co	Expansion	Announced	2013	PA	8	240	N/A
1/22/10	Dominion Keystone Pipeline	Dominion Transmission	Lateral	Announced	2013	PA	240	500	N/A
4/6/12	Northeast Connector	WILLIAMS	Expansion	Announced	2013	PA		100	N/A
4/6/12	TETCO TEAM 2013 Expansion	Texas Eastern Transmission	Expansion	Announced	2013	PA		500	N/A
4/6/12	North-South II Capacity Expansion and Extension	Inergy LP	Expansion	Announced	2013	PA,NY	3		N/A
4/6/12	East Side Expansion Project	NiSource Gas Transmission & Storage	Expansion	Announced	2014	PA		500	N/A
4/6/12	West Side Expansion Project	NiSource Gas Transmission &	Expansion	Announced	2014	PA		250	N/A

		Storage							
4/6/12	Algonquin Incremental Market (AIM)	Algonquin Gas Transmission	Expansion	Announced	2014	PA,NY, CT,RI, MA			N/A
3/12/12	Commonwealth Pipeline	UGI Corp/Inergy LP/WGL Holding	New Pipeline	Announced	2015	PA,MD	200	780	N/A
7/10/12	Constitution Pipeline	Constitution Pipeline Co	New Pipeline	Announced	2015	PA,NY	121	650	N/A
8/9/12	MPP Project	Tennessee Gas Pipeline Co	Expansion	Approved	2013	PA	7.9	240	CP12-28
8/7/12	Northeast Upgrade Project	Tennessee Gas Pipeline Co	Expansion	Approved	2013	PA,NJ	40.3	636	CP11-161 CP11-161
2/14/11	AES Mid-Atlantic Express Project	AES Sparrows Point LNG LLC	New Pipeline	Approved	2013	MD,PA	88	1500	CP07-62
Sources: Federal Energy Regulatory Commission (FERC), trade press, company websites, SNL Financial, and BENTEK Energy LLC (Bentek) Available from EIA at Web Page: http://www.eia.gov/naturalgas/data.cfm									

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