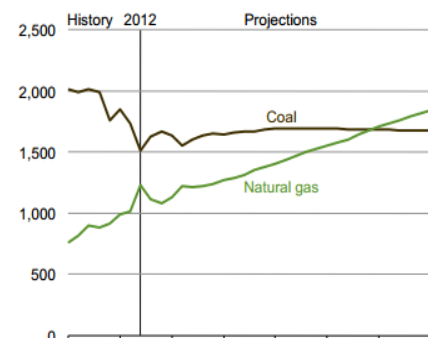


## History of Shale Gas Development Policy

The United States has experienced the most rapid and effective exploration of shale gas resources, with hundreds of thousands of wells across the nation in 2014 (Administration, 2014). Natural gas within sandstone (shale) formations was not economically recoverable until horizontal drilling techniques and precise 3D seismic mapping combined with the discovery of ‘slickwater’ hydraulic fracturing fluid in the 1990’s. The economic viability of the industry was achieved solely through decades of federal research initiatives, industry tax incentives and subsidies, and public-private partnerships. Federal policies have largely led the way in establishing the research and design which led the industry to fruition. The increased supply of natural gas has lowered gas prices, increased price stability, and begun a transformation in the electrical generation industry to cleaner natural gas.

The Energy Information Administration predicts that the US will see a 44% increase in natural gas production over the next 25 years due largely to unconventional shale gas sources, while exports are expected to quadruple in this time (Administration, 2014). Over 20 liquefied natural gas export docks are planned for construction in Texas, Maryland, Louisiana, Washington and Oregon, with several in Texas and the Gulf of Mexico already underway (Commission, 2013). Shale gas is expected to make up half of the US natural gas supply by 2035 following the industry’s tremendous growth through the use of fractured well staging and ‘slickwater’ chemical compounds to effectively force fissures open (Administration, 2014).



**FIGURE 1 - EIA US ELECTRICITY GENERATION (BILLION KWH)**  
 (Administration, 2014)

The EPA is the main federal agency responsible for monitoring and defining safe environmental conditions, and plays an active role in supporting policy creation and judicial reviews. The Department of the Interior’s Bureau of Land Management presides over all gas and oil exploration and production projects on federal and Indian lands. In addition, the Department of Energy plays critical roles in the technology and engineering required to safely extract gas from shale formations.

In hydraulic fracturing, the main environmental concerns involve groundwater contamination and air pollution. During the hydraulic fracturing of a well, 1 to 5 million gallons of water (>95%) and sand with chemical additives (<5%) are forced into the well and fissures (Commerce, 2010). In the process of recovering gas after the fracturing, significant wastewater is brought back to the surface through the well, referred to as “flowback”. This effluent is most commonly pumped back into the ground in designated underground injection control wells (such as in Texas’ Barnett Shale, much less commonly in the mid-east Marcellus Shale) (Agency, 2012). Some flowback is recycled and reused by being filtered for suspended solids and then combined again with water and additives, however flowback water reuse makes up a small percentage of required fracturing fluid. If flowback is not pumped underground or reused, it is stored in open ponds and allowed to evaporate, stored in closed tanks, or transported to a public wastewater facility not typically designed for industrial/hazardous wastes (specifically struggling with the removal of dissolved solids, natural occurring radioactive material, and metals).

Despite the environmental challenges that hydraulic fracturing presents in natural gas development, the natural gas has generally lower pollution rates when burned, as compared with traditional coal or oil sources (Commerce, 2010). The method of resource extraction aside, natural gas is a less damaging pollutant than coal and oil. Fossil fuel power plants account for 2/3 of all sulfur dioxide emissions, 1/4 of all nitrogen oxide and almost 1/2 of all carbon dioxide. Natural gas power plants produce just 1/2 the carbon dioxide and 1/3 the nitrogen oxide as coal-fired power plants, while emitting almost none of the sulfur oxides that coal emits (EPA, Clean Energy, 2013). While natural gas may emit less pollution than coal when burned, the process of extracting natural gas by hydraulic fracturing may well reduce some relative environmental benefits, specifically with regard to local water source quality. Natural gas wells can leak methane gas at a rate between 2-10% of that captured, leading question to whether the life-cycle carbon footprint of coal or gas is more efficient (Webster, 2013). This remains in debate, though technological advancements and legislation have proven to capture fugitive emissions (Institute, 2013).

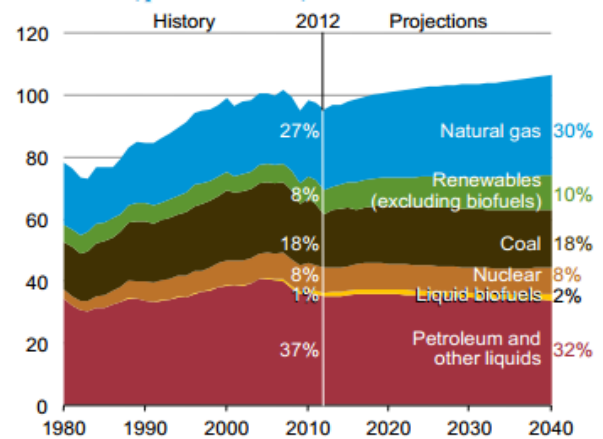


FIGURE 2 - US PRIMARY ENERGY BY FUEL (QUADRILLION BTU)  
 (Administration, 2014)

A transition from coal to natural gas for electrical production and transportation purposes will slow human impact on greenhouse gas rates, but will not prevent significant global warming (EPA, Clean Energy, 2013). Natural gas may improve air quality in some locations over coal and may lower relative carbon emissions, however the overall impact of shale gas will not deter the nation and world from inevitable effects of global warming and climate change as a result of fossil fuel extraction and consumption. Natural gas will, at current, only supply the growing demand for energy, while other forms of energy will continue to be used at rates similar to the present.

Major federal legislative initiatives to address pollution which apply to shale gas development include the:

Clean Air Act (CAA)

Regulate and research airborne pollutants

National Environmental Policy Act (NEPA)

Requirements for environmental impact statements for some federal projects

Water Pollution Control Act/Clean Water Act (CWA)

Report and regulate discharges

Safe Drinking Water Act (SDWA)

Protect above and below ground drinking water sources

Resource Conservation and Recovery Act (RCRA)

Manage the disposal and reduction of waste, resource conservation

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)

Clean sites with hazardous substances

Windfall Profits Tax Act (WPTA)

Provide tax credits for recovering gas from unconventional sources

Emergency Planning and Community Right-to-Know Act (EPCRA)

Prepare for emergencies involving hazardous substances

Energy Policy Act

2005 law which amended several of the previously mentioned statutes

The following timeline provides an understanding for how US shale gas policy has evolved given federal interventions and through several critical state and local laws & lawsuits.

**1930's** – First horizontal wells drilled (not made common in the 1970's).

**1947** – First hydraulic fracturing experiment to extract natural gas in limestone rock.

**1963 – Clean Air Act (CAA)** of 1963 established a research initiative to define regulatory controls for air pollution, with amendments based on findings passed in 1970, 1977, and 1990.



**1969 – National Environmental Policy Act (NEPA)**

was established to require federal agencies to conduct environmental assessments and impact statements for federal actions that would significantly alter the human environment. Any federal mining or extraction projects on federal land were required to submit environmental impact statements before a rebuttable presumption was included in the 2005 Energy Policy Act.

**1970 – CAA** amended with the Establishment of Federal Standards and Enforcement for Air Pollution. Regulation of particulate matter, lead, ozone, NO<sub>x</sub>, Carbon Monoxide, SO<sub>x</sub>.

**1971** – EPA Established.

**1972 – Federal Water Pollution Control Act (WPCA)** amended to require permitting for discharge into any water bodies using the National Pollutant Discharge Elimination System (NPDES).

**1974 – Safe Drinking Water Act (SDWA)** established to protect potential above and below drinking water resources. Part C Section 1421 established regulations for State Underground Injection Control Programs which hydraulic fracturing activities *were* considered to be subject to, until this section was amended by the Energy Policy Act of ground 2005.

**1976 – Resource Conservation and Recovery Act (RCRA)** to monitor the potential hazards of waste disposal, conserve energy and natural resources, reduce waste, and ensure waste is managed in an “environmentally sound” manner. Subtitle C provides the EPA authority to regulate hazardous waste, as defined by the EPA.

DOE’s Energy Research and Development Administration (ERDA) launches the Unconventional Gas Research (UGR) program and the Morgantown Energy Research Center (MERC), leading to the Eastern Gas Shales Projects - a partnership with universities and industry firms to test drilling and fracturing methods to make shale gas development commercially viable.

Directional shale drilling is pioneered by the MERC.

**1977** – **WPCA** is amended as the **Clean Water Act (CWA)**, establishing the regulating structure for point source discharges into water bodies and water and wastewater quality standards, and effluent reduction levels.

**1978** – The EPA issues a listing of hazardous chemicals, which included oil and gas field wastes as “special wastes” under **Subtitle C of the RCRA** and were designated to be regulated. The signal displayed the intent of the EPA to regulate oil and gas site operations – the executive branch of the federal government compelled the legislature to take preventative action before the EPA’s enforcement began.



**1980** – **RCRA** amended by Congress, effectively **overruling the EPA**, providing exemption under

Subtitle C for oil field wastes unless and until the EPA could prove waste was a danger to human health and the environment (initiating a research study which was completed in 1988).

**Windfall Profits Tax Act (WPTA)** established a production tax credit (under Section 29 credit) for unconventional gas, enabling some shale gas projects to attract investment capital, driving technological innovation and production of unconventional sources by trial. This tax credit was in effect from 1980 until 2002, providing energy firms an additional \$0.50 per thousand cubic feet for natural gas from unconventional sources.

Congress passes the **Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)**, commonly known as the Superfund Act, to clean sites with hazardous substances dumped into the environment. If the toxic substances are found within a mixture containing crude oil, petroleum or natural gas, it is exempt from the cleanup process. Hazardous substances include benzene and toluene, both compounds in petroleum, yet crude oil and petroleum are specifically excluded from the list.

**1986** – Congress passes the **Emergency Planning and Community Right-to-Know Act**

(**EPCRA**) for emergencies involving the release of hazardous substances. The Toxic Release Inventory Reporting (Section 313) of the EPCRA requires the EPA and States to collect data on the releases or transfers of toxic chemicals. Oil and gas facilities are not included in the Standard Industrial Classification list, at the discretion of the Administrator of the EPA, despite meeting all the criteria to require reporting.

The first successful multi-fracture horizontal well is drilled in Wayne County, WV Devonian shale by a joint private and DOE venture.

**1987** – Water Quality Act amended to the **CWA** to require stormwater runoff NPDES permits for municipal, industrial, and construction site storm water runoff. The WQA included exemptions for ‘uncontaminated’ stormwater discharges from oil and gas exploration, production, processing, treatment, and transmission.

**1988** – EPA Regulatory Determination ultimately agrees with Congress’s exemption of oil and gas wastes in the **RCRA** due to “adequate” state and local regulations and potentially “significant” detrimental economic impact of additional regulation under Subtitle C. Despite the finding that between 10-70% of wastes from sites could exhibit the hazardous waste characteristics defined in the RCRA, the Subtitle C exemption was confirmed by the EPA. As a result of this rule, flowback (wastewater) from wells is permitted to be brought to public water treatment facilities.

**1990** – **CAA** is amended to expand the EPA’s ability to regulate hazardous air pollutants. National Emissions Standards for Hazardous Air Pollutants are established, including Federal Title V Permitting requirement for aggregated stationary air pollutant sources. Major sources do not include aggregated area sources of oil and gas production sites, allowing gas and oil activities to avoid Title V CAA permits. The CAA also excludes accidental hydrogen sulfide leaks from well operations.

**1991** – Mitchell Energy & Development drills horizontal wells in the Texas Barnett shale with support (subsidies) from the DOE’s Gas Research Initiative.

**1997** – 11<sup>th</sup> Circuit Court in Alabama orders the EPA to reevaluate position on hydraulic fracturing due to a lawsuit brought by Legal Environmental Assistance Foundation asserting that hydraulic fracturing should fall within the scope of regulations under the **SDWA** Section C for underground injection control programs. This ruling applies only for the state of Alabama.



**1998** – Mitchell Energy & Development refines the first “slick water” hydraulic fracturing fluid, a mixture of water, sand, and gelling agent from the guar bean. This fluid mixture was the breakthrough component of modern fracturing, combining horizontal well drilling and precise 3D seismic imaging of sandstones to extract tight gas reserves. The result is the first commercially-profitable shale gas production well.

**1999** – EPA and Interstate Oil and Gas Compact Commission form the State Review of Oil and Natural Gas Environmental Regulations (**STRONGER**), a non-profit organization assisting in documenting environmental regulation of gas and oil exploration and production. The program highlights voids in state laws and regulations, and recommends best management practices for industry and government consideration (**STRONGER**, 2014).

**2003** – EPA enters a voluntary memorandum of agreement with Halliburton, BJ Services, and Schlumberger to eliminate diesel fuel from hydraulic fracturing fluids (EPA, Elimination of Diesel Fuel in Hydraulic Fracturing Fluids Injected into Underground Sources of Drinking Water During Hydraulic Fracturing of Coalbed Methane Wells , 2013).

**2004** – EPA releases its Phase I study of impacts of hydraulic fracturing of coalbed methane reservoirs on underground sources of drinking water (USDW), concluding that “...injection of hydraulic fracturing fluids into coalbed methane wells poses little or no threat to underground sources of drinking water, and does not justify additional study.” These findings were referenced in passages of the 2005 Energy Policy Act to exclude all hydraulic fracturing activities in various formation types from the **SDWA** (EPA, Evaluation of Impacts to Underground Sources of Drinking Water by Hydraulic Fracturing of Coalbed Methane, 2004).

**2005** – **Energy Policy Act** provides exemptions for waste water from gas and oil construction activities which include oil and gas exploration, production, process, or treatment and

transmission facilities (all major components of production) from the underground injection control program of the **SDWA** (“Halliburton Loophole”) (Congress, 2005).

Section 390 of the Energy Policy Act established a rebuttable presumption that certain oil and gas activities authorized by the DOI and BLM are subject to “categorical exclusion” under the **NEPA**. Activities under the Mineral Leasing Act of 1920 and exploration and extraction of natural gas are exempt from NEPA due to a blanket finding of no significant impact unless proved otherwise, putting the burden on the public to prove that the oil and gas activities have significant environmental impact (Congress, 2005).

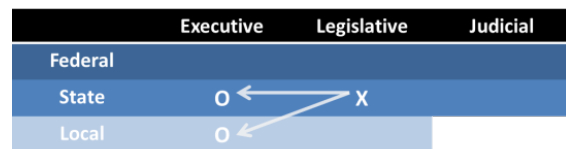
In Section 323 of the Energy Policy Act, it is specified that the EPA shall not require NPDES permits for stormwater discharges of sediments from oil and gas sites and thereby amending the **CWA** to allow for ‘uncontaminated’ sediment discharges without permitting or reporting (Congress, 2005).

**2008** – Ninth Circuit Court of Appeals issued an opinion in the Natural Resources Defense Council v. US EPA that narrowed the EPA’s



sweeping effective exemption policy formed after the 2005 Energy Policy Act. In this ruling, the Court restricted exemptions for stormwater runoff permits to only cases in which stormwater is entirely within a system of conveyances and does not come into contact with hazardous material, and may only contain sediment runoff without any reportable amount of hazardous waste (Lazarus, 2012).

**2010** – New York Governor David Paterson vetoes legislation to place a moratorium on shale gas fracturing until further study, and instead writes his own executive order to more clearly define the moratorium on horizontal high-volume fracturing until further study.





## History of Shale Gas Development Policy

**2012** – The White House issues a “Blueprint for a Secure Energy Future” to establish a multi-agency program to address the highest priority challenges associated with safe and prudent development of unconventional shale gas and tight oil resources. The program was created to support sound policy

decisions by state and Federal agencies for ensuring prudent development of energy sources while protecting human health and the environment.

The EPA issues a rule that it will regulate volatile organic compound emissions from gas wells and operations, with enforcement beginning in 2015. The practice of flaring (burning of less-economical fuel) will be replaced by ‘reduced emissions completions’ to capture natural gas.

**2013** – President Obama and Congress enact legislation to expedite the permitting of hydraulic fracturing wells on federal lands in the Bakken Shale basin in North Dakota.

### ***Federal Multi-Agency Collaboration on Unconventional Oil and Tight Gas***

In the 2012 multi-agency collaboration on unconventional oil and tight gas, the DOE is responsible for wellbore integrity, flow and control, new technologies, and imaging and materials in gas activities. The DOI and its United States Geological Survey subdivision are responsible for the assessment of resources, hydrology and geology of the reserves, and the land use, wildlife, and ecological impacts. The EPA is responsible for air and water quality monitoring, and environmental and human health risk impact assessments. The agency was established to create a multi-year research plan to comprehend knowledge of unconventional sources, prioritize new research, understand safety and environmental sustainability risks, and promote transparency and stakeholder participation.

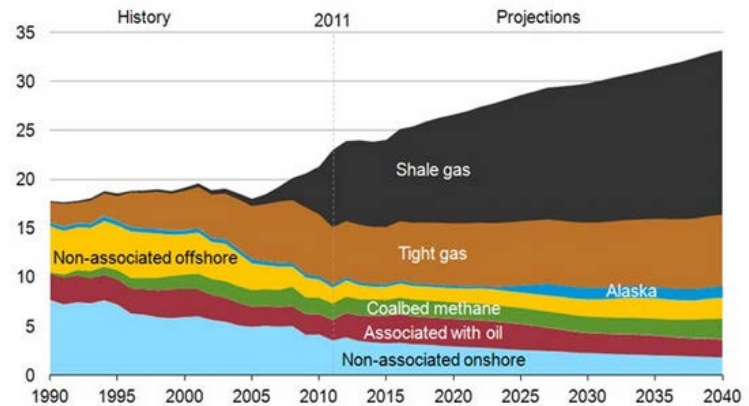


FIGURE 3 - US EIA DRY NATURAL GAS BY SOURCE  
INVALID SOURCE SPECIFIED.

## Department of the Interior

The nation's onshore and offshore natural gas, oil and mineral resources were previously managed by the DOI's Minerals Management Services, established in 1982 and tasked in 1983 with carrying out the requirements of the Federal Oil and Gas Royalty Management Act. In 2010, President Obama and Interior Secretary Ken Salazar established the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) to replace the MMS. With the 2005 Energy Policy Act, the MMS began to develop renewable energy projects on the OCS. The BOEMRE is divided into three agencies which handle: evaluation, planning and leasing; oversight and environmental protection; and royalties and revenue management. In 2009, the U.S. House Oversight Committee reported the loss of billions in revenue resulting from MMS mismanagement and coercion with industry officials (Juliet Eilperin, 2010).

The DOI is also responsible for managing fracturing projects on federal land (generally Bureau of Land Management). The DOI began implementing safety and disclosure standards for federal land projects in 2011, and revised the standards in 2013 after significant public comment. Approximately 90% of wells on federal land use hydraulic fracturing, and the revised rules help establish modern environmental safeguards including the required disclosure of chemical use, improvements to wellbore integrity that ensure protection of groundwater sources, and flowback water treatment plans (Interior, 2013). The BLM is also considering what options exist for flowback water containment, either via storage tanks or open pits. With over 90,000 gas and oil wells, the BLM administers wells on public lands that account for more than 13% of the nation's natural gas production and 5% of oil.

## **Department of Energy**

The DOE plays an integral role in supporting the technological research and developments that support industry improvements. The DOE is responsible for the engineering and science behind technology being used. In an effort to reduce fugitive gas from well heads, the DOE supports research into well integrity studies, in addition to the integrity with respect to groundwater protection. The DOE is involved in the definition and description of chemical additives used in the fracturing process, and flowback water treatment processes and filtration technologies. In addition, the DOE supports technical research on underground injection programs. In 2011 the Obama administration commissioned the DOE to study improvements for the safety and environmental performance of hydraulic fracturing operations in shale formations.

## **Environmental Protection Agency**

The EPA has been at the center of the hydraulic fracturing debate, attempting to decipher legislative initiatives while maintaining primary interest in the environmental protection of humans and wildlife. The EPA serves to fill voids in state operations and regulatory management of fracturing projects. In 2010, Congress directed the EPA to conduct a comprehensive research study into potential adverse impacts of fracturing on water quality and public health, a report of which should be available in 2014.

In a February 5<sup>th</sup> 2014 memorandum the Environmental Protection Agency's Office of Inspector General (OIG) announced that it was starting "preliminary research on the EPA's and states' ability to manage potential threats to water resources from hydraulic fracturing." Specifically the OIG wants to evaluate the regulatory authority that is available to the EPA and the states, identify potential threats to water resources from fracturing operations, and evaluate how the EPA and the states have responded to these threats. This research is concurrent with the EPA's on-going assessment of the potential impacts of hydraulic fracturing on drinking water resources, a project in which a draft report is expected to be released for public comment and peer review in mid-2014.

## ***Pennsylvania Shale Gas Development***

Each state has varying regulations and practices for shale gas extraction, all of which are in a transition as new research is conducted and communities react to exploration and production projects. Variations in policies from state to state include differences in setback distances (from wells to buildings, water sources, etc), chemical disclosure requirements, pre-drilling water testing analysis, drilling and casing standards, venting and flaring restrictions, water withdrawal permitting, wastewater fluid storage procedures, and underground injection restrictions. In many states there are initiatives to require permitting and reporting of fracturing activities, disclosure of fracturing fluid chemicals, and development of wastewater disposal practices.

Pennsylvania is among the more active of states involved in the shale gas development boom, and has experienced significant gas production while being home to several unique legislative initiatives and judicial rulings.

**2007** – 122 well permits granted in Marcellus Shale in Pennsylvania

**2008** – Shale boom established in Pennsylvania, with most productive wells in NE corner

**2010** – Former Governor Ed Rendell passes an amendment for improved oil and gas well casing and cementing, strengthening construction requirements and imposing greater obligation on operators to replace any contaminated waters.

Civil action suit filed in Pennsylvania by 13 families alleging water wells were contaminated due to gas drilling operations conducted by Southwest Energy Production Company (Civil Action #2010-1882CP). The complaint claims that the company began using hydraulic fracturing in 2008, and that negligent drilling, construction and operation of the well has allowed pollutants to be discharged into the ground waters. Residents all lived and had water wells within 1600 feet of the gas production well.

**2011** – 3,249 well permits granted in Marcellus Shale in Pennsylvania

Gov. Tom Corbett's Marcellus Shale Advisory Commission issues a report detailing a comprehensive, strategic plan for the responsible development of natural gas drilling after conducting 20 public meetings and outreach with experts and citizens.

**2012** - February - Marcellus Shale Law – Pennsylvania H.B. 1950 was signed by Gov. Tom Corbett, commonly referred to as Act 13 which amends Chapter 58 of the Oil and Gas Act. The law changes the zoning laws applicable to the Marcellus Shale well drilling, requires municipalities to allow drilling and wastewater pits in all zones (with buffers) and at all times of day. The law indicates the potential to construct a gas pipeline across the state to Maryland and other neighbor states. The law allows the state to supersede local regulations and restrictions on drilling, forcing localities to allow drilling even in residential zones where bans exist. An approximately \$45,000 fee was placed on wells drilled in the Marcellus Shale, dependent on gas prices. About 60% of the fees stay in the municipality, while the remaining fees go to funding various state agencies. The law additionally bars local governments from receiving royalties on gas extraction if zoning laws are enacted that extend beyond those established by Act 13. The law prevents municipalities from contesting drilling permits issued by the PA DEP, which historically approves over 95% of permit applications. In healthcare situations where a patient has been affected by hydraulic fracturing, doctors are not allowed to disclose any chemical information with the patient or colleagues. Positively, the Act authorizes millions in transfer from the Oil and Gas Lease Fund to the Environmental Stewardship fund for environmental support. Act 13 established minimum setback distances from the well and pad to open water and wetlands, and expands the presumed liability from 1,000 to 2,500 feet to ensure gas and oil activities are tied to environmental cleanup efforts in the case of contamination. The Act also increased bond requirements and required the disclosure of chemical additives used in the fracturing process (Boone, 2012).

**2013** – 6,300 active shale wells and over 3,300 violations of state regulations since 2009 for fines totaling nearly \$5 million.

April - The Pennsylvania Supreme Court reversed a court of appeals decision, reinstating a trial court's decision that a property deed's mineral rights do not include natural gas unless expressly defined, citing an 1882 PA Supreme Court decision (*Dunham v. Kirkpatrick*) that "all minerals" does not constitute reservation of oil or gas (Pennsylvania, 2013).

July - Pennsylvania's Commonwealth Court in a 4-3 decision repeals the restrictions placed on local governments' ability to zone and regulate gas drilling activities. The Court determined that Act 13 violated the municipalities' substantive due process, unconstitutionally preventing governments from the right to separate the industrial and residential zones. The ruling also revoked portions of Act 13 which granted the DEP rights to waive setback distances from gas wells to water sources, thereby also waiving the minimum setback distances from well pads to water sources and wetlands (*Seamans*, 2012).

Gov. Corbett's administration appeals the decision to the Supreme Court of Pennsylvania.

December - PA Supreme Court issued an 4-2 decision which struck many provisions in Act 13, siding with the Commonwealth Court on most decisions. The ruling held that the Act 13 zoning restrictions were unconstitutional, giving zoning autonomy back to localities. The court determined the zoning and statewide umbrella zoning laws violate the Environmental Rights Amendment which guarantees the right to clean air, water and environment. The ruling also struck down the "local preemption" portion of the law which had given the Public Utilities Commission the option to revoke the drilling "impact fee" if a municipality attempted to enforce restrictions above and beyond the State's (*StateImpact*, 2013) (Pennsylvania, 2013).

**2014** – January – Gov. Corbett's administration asks Supreme Court to reconsider the December 2013 decision after making the decision without the state providing evidence in support of the Act, however the Supreme Court rejects the request (*Law360*, 2014).

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