



Marcellus Shale: The Economic Impacts

American Petroleum Institute
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Table E-1. Total Impacts of the Oil and Natural Gas Industry's Operations and Capital Investments on the U.S. Economy, 2009

Item	Amount	Percent of U.S. Total
<i>Operational Impact</i>		
Employment*	7,978,636	4.6%
Labor Income (\$ millions)**	\$466,869	5.3%
Value Added (\$ millions)	\$966,324	6.8%
<i>Capital Investment Impact</i>		
Employment*	1,181,930	0.7%
Labor Income (\$ millions)**	\$66,679	0.8%
Value Added (\$ millions)	\$115,377	0.8%
<i>Total Impacts</i>		
Employment*	9,160,566	5.3%
Labor Income (\$ millions)**	\$533,548	6.0%
Value Added (\$ millions)	\$1,081,701	7.7%

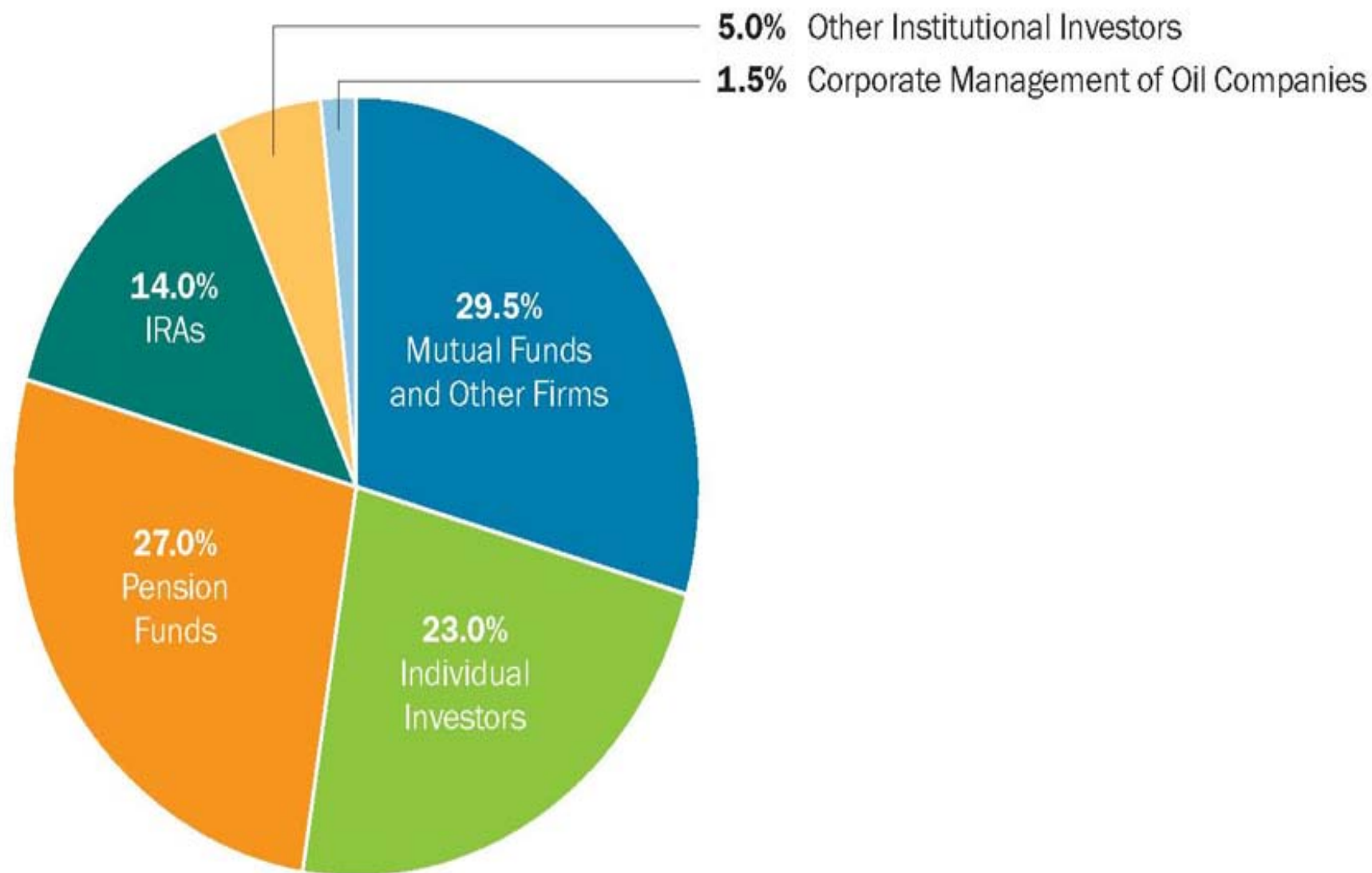
Source: PwC calculations using the IMPLAN modeling system (2009 database).

Details may not add to totals due to rounding.

* Employment is defined as the number of payroll and self-employed jobs, including part-time jobs.

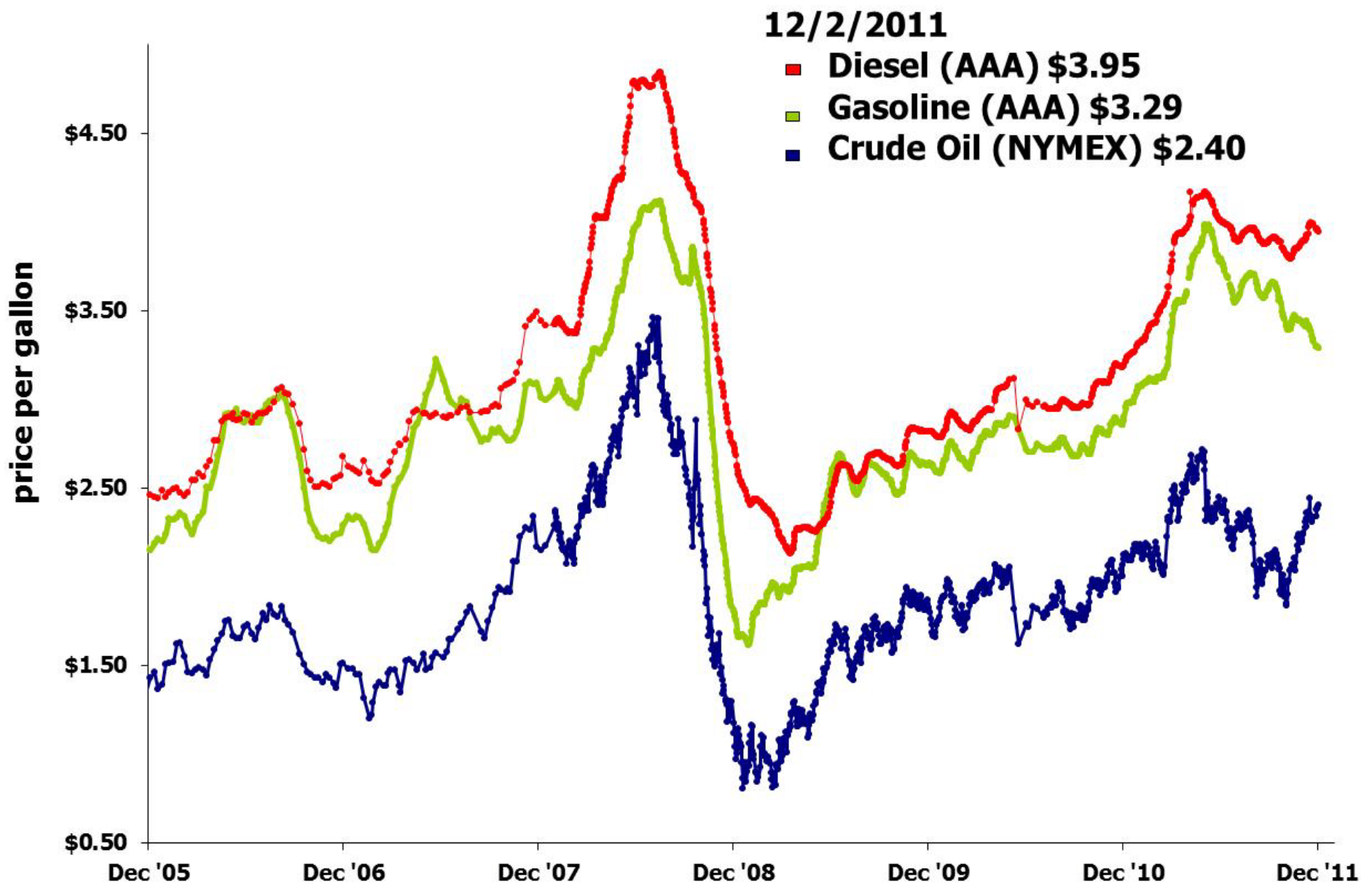
** Labor income is defined as wages and salaries and benefits as well as proprietors' income.

Who Owns “Big Oil?” (Holdings of Oil Stocks, 2007)



Source: *The Distribution of Ownership of U.S. Oil and Natural Gas Companies*, SONECON, September 2007

Diesel, Gasoline and Crude Prices

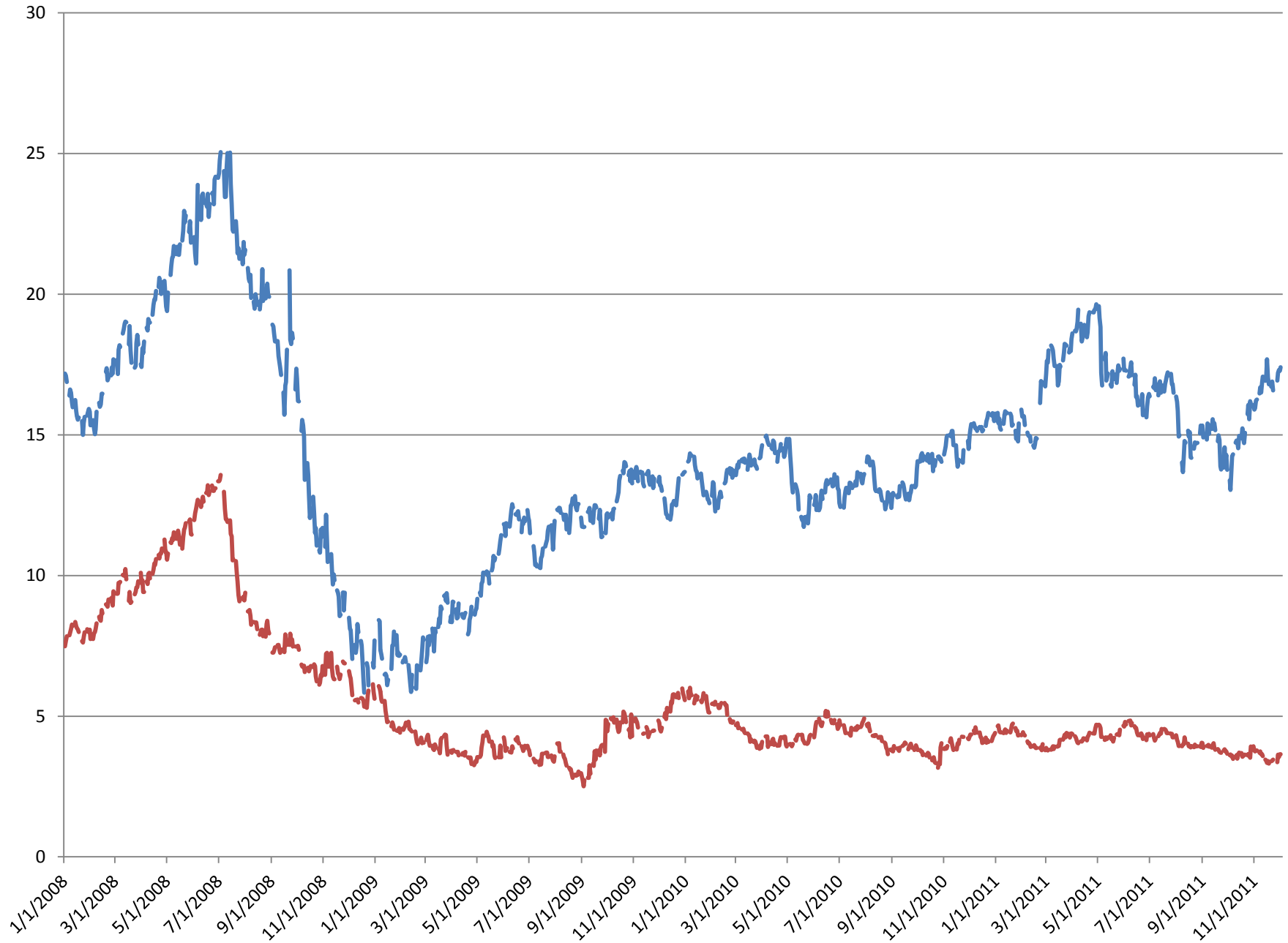


Source: NYMEX (WTI crude oil) and AAA (gasoline and diesel)

Oil prices relate to many uncertain factors



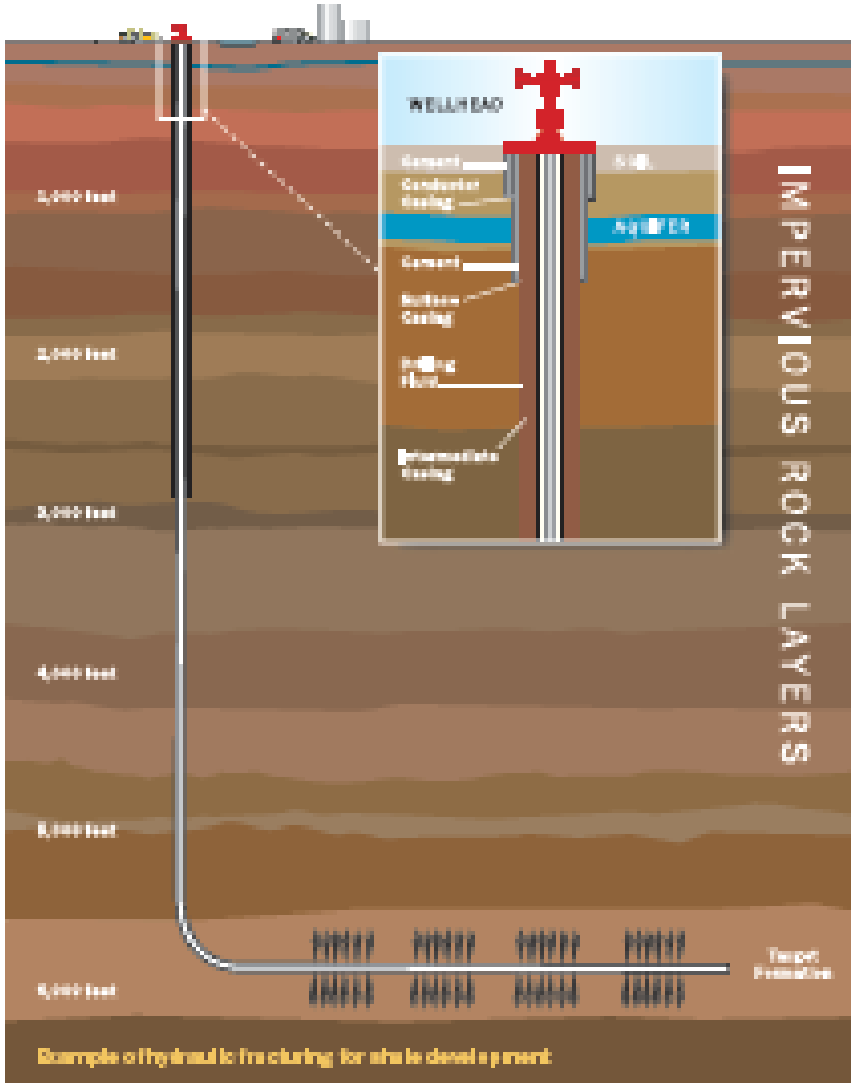
NYMEX Prices for Crude oil and Natural Gas



North American shale plays (as of May 2011)



Proper well construction provides groundwater protection.



Typically, steel pipe known as surface casing is cemented into place at the uppermost portion of a well for the explicit purpose of protecting the groundwater. The depth of the surface casing is generally determined based on groundwater protection, among other factors. As the well is drilled deeper, additional casing is installed to isolate the formation(s) from which oil or natural gas is to be produced, which further protects groundwater from the producing formations in the well.

Casing and cementing are critical parts of the well construction that not only protect any water zones but are also important to successful oil or natural gas production from hydrocarbon bearing zones.

Industry well design practices protect sources of drinking water from the other geologic zones of an oil and natural gas well with multiple layers of impervious rock.⁸

4. Identify the categories equipment types and operating practices for equipment using the production test data. Examples: **Process** A.M.I. 3.3 series Publications: **Subcategory**: A.M.I. 7 series Publications: **Energy equipment**: A.M.I. 1.8 series Publications: **Process equipment**: A.M.I. 2.8 series Publications: **Production equipment**: A.M.I. 1.3 series Publications: **Energy use equipment**.

Typical Chemical Additives Used in Frac Water

Compound	Purpose	Common application	
Acids	Helps dissolve minerals and initiate fissure in rock (pre-fracture)	Swimming pool cleaner	
Sodium Chloride	Allows a delayed breakdown of the gel polymer chains	Table salt	
Polyacrylamide	Minimizes the friction between fluid and pipe	Water treatment, soil conditioner	
Ethylene Glycol	Prevents scale deposits in the pipe	Automotive anti-freeze, deicing agent, household cleaners	
Borate Salts	Maintains fluid viscosity as temperature increases	Laundry detergent, hand soap, cosmetics	
Sodium/Potassium Carbonate	Maintains effectiveness of other components, such as crosslinkers	Washing soda, detergent, soap, water softener, glass, ceramics	
Glutaraldehyde	Eliminates bacteria in the water	Disinfectant, sterilization of medical and dental equipment	
Guar Gum	Thickens the water to suspend the sand	Thickener in cosmetics, baked goods, ice cream, toothpaste, sauces	
Citric Acid	Prevents precipitation of metal oxides	Food additive; food and beverages; lemon juice	
Isopropanol	Used to increase the viscosity of the fracture fluid	Glass cleaner, antiperspirant, hair coloring	

Source: DOE, GWPC: Modern Gas Shale Development in the United States: A Primer (2009).

Hydraulic Fracturing is Well Regulated

Hydraulic fracturing is **well regulated** by multiple federal, state and local authorities addressing environmental protection during natural gas operations, covering such items as well permitting, well materials and construction, **safe disposition of used hydraulic fracturing fluids, water testing, and chemical recordkeeping and reporting.** These rules and industry practices **effectively protect underground sources of drinking water.**

Overview of Industry Guidance/Best Practices on Hydraulic Fracturing (HF)

HF1 – Hydraulic Fracturing Operations – Well Construction and Integrity Guidelines, 1st Edition, October 2009, (API)

- Highlights industry practices for well construction and integrity for wells that will be hydraulically fractured.
- The guidance identifies actions to protect shallow groundwater aquifers, while also enabling economically viable development of oil and natural gas resources.

HF2 – Water Management Associated with Hydraulic Fracturing, 1st Edition, June 2010, (API)

- Identifies best practices used to minimize environmental and societal impacts associated with the acquisition, use, management, treatment, and disposal of water and other fluids associated with the process of hydraulic fracturing.
- Focuses primarily on issues associated with hydraulic fracturing pursued in deep shale gas development, but also describes the important distinctions related to hydraulic fracturing in other applications.

HF3 – Practices for Mitigating Surface Impacts Associated with Hydraulic Fracturing, 1st Edition, February 2011, (API)

- Identifies the best practices for minimizing surface environmental impacts associated with hydraulic fracturing operations.
- Focused on protecting surface water, soils, wildlife, other surface ecosystems, and nearby communities.
- Includes API's policy on chemical disclosure:
 - API supports transparency regarding the disclosure of the chemical ingredients;
 - States are the proper authority to determine reporting requirements and formatting of reporting and public disclosure;
 - Proprietary information should be protected; and
 - Hydraulic fracturing is effectively regulated by numerous federal, state and local requirements. Hydraulic fracturing should not be placed exclusively under the purview of the Safe Drinking Water Act (SDWA) or any other federal statute.

Overview of Industry Guidance/Best Practices on Hydraulic Fracturing (HF)

Std 65 Part 2 – *Isolating Potential Flow Zones During Well Construction*, 2nd Edition, December 2010, (API)

- Identifies best practices used to minimize environmental and societal impacts associated with the acquisition, use, management, treatment, and disposal of water and other fluids associated with the process of hydraulic fracturing.
- Focuses primarily on issues associated with hydraulic fracturing pursued in deep shale gas development, but also describes the important distinctions related to hydraulic fracturing in other applications.

RP 51R – *Environmental Protection for Onshore Oil and Gas Production Operations and Leases*, 1st Edition, July 2009, (API)

- Provides environmentally sound practices for domestic onshore oil and gas production operations, including fracturing. Applies to all production facilities, including produced water handling facilities. Operational coverage begins with the design and construction of access roads and well locations, and includes reclamation, abandonment, and restoration operations.
- **Annex A provides guidance for a company to consider as a “Good Neighbor.”**

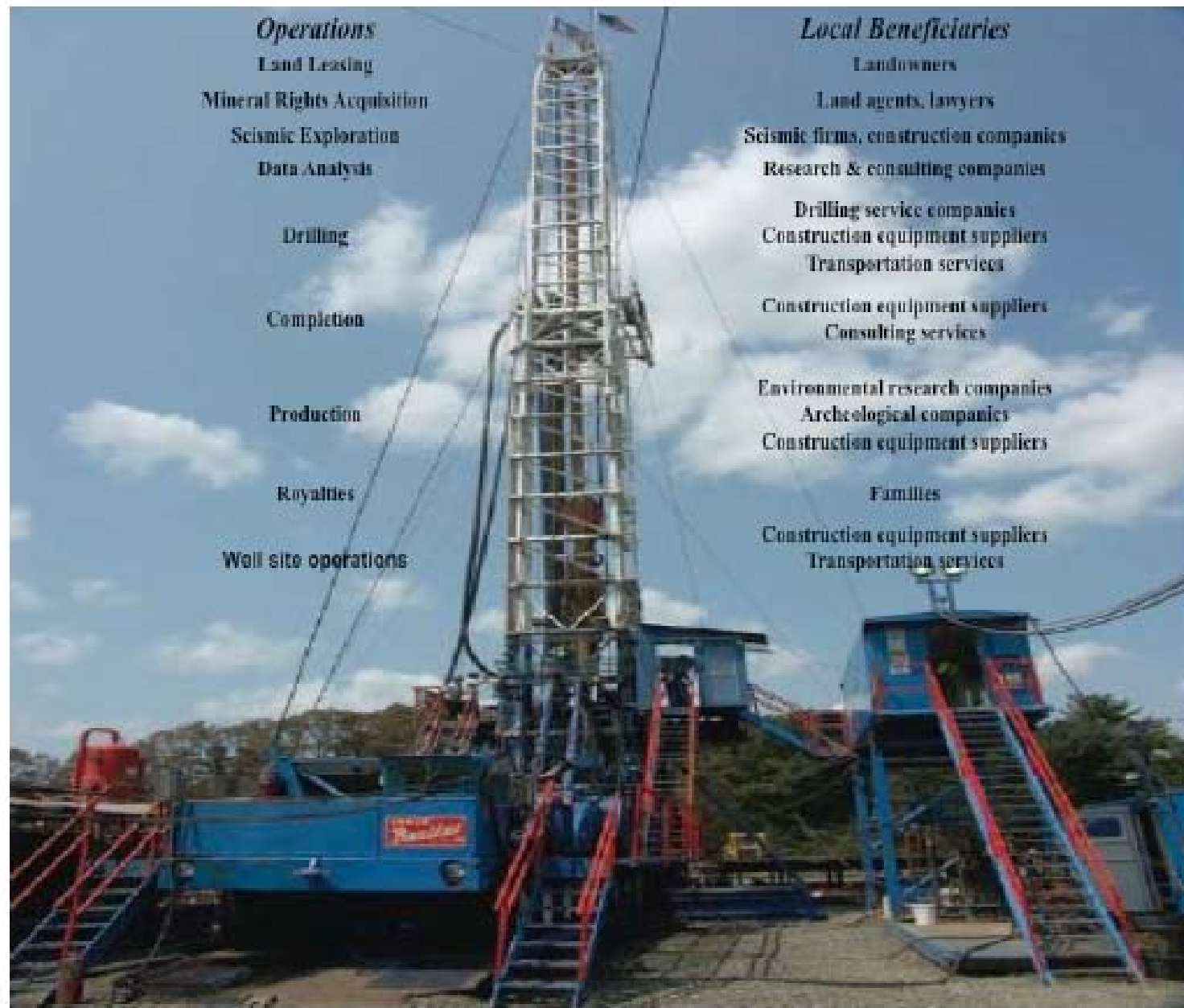


Figure 14: Natural Gas Development Activities and Local Beneficiaries

Table 6. The Direct, Indirect, and Induced Impacts of the Oil and Natural Gas Industry to the U.S. Economy, 2009

Sector Description	Employment*	Labor Income** (\$ million)	Value Added (\$ million)
Direct Impact of the Oil and Natural Gas Industry	2,192,392	\$176,305	\$464,574
Indirect and Induced Impact on Other Industries	6,968,174	\$357,243	\$617,126
<i>Operational Impact</i>	5,786,244	\$290,564	\$501,749
Agriculture	91,218	\$2,580	\$3,510
Mining	12,982	\$913	\$2,235
Utilities	27,397	\$3,554	\$12,091
Construction	122,132	\$6,027	\$7,207
Manufacturing	396,459	\$27,933	\$50,156
Wholesale and retail trade	883,136	\$40,242	\$67,406
Transportation and warehousing	249,301	\$12,486	\$17,256
Information	117,511	\$10,495	\$20,881
Finance, insurance, real estate, rental and leasing	771,363	\$35,111	\$139,389
Services	2,890,314	\$136,279	\$164,592
Other	224,431	\$14,944	\$17,026
<i>Capital Investment Impact</i>	1,181,930	\$66,679	\$115,377
Agriculture	15,524	\$460	\$659
Mining	3,080	\$216	\$541
Utilities	3,740	\$483	\$1,763
Construction	9,482	\$454	\$588
Manufacturing	196,690	\$14,966	\$25,355
Wholesale and retail trade	194,274	\$10,099	\$17,648
Transportation and warehousing	51,281	\$2,587	\$3,807
Information	32,896	\$3,259	\$6,886
Finance, insurance, real estate, rental and leasing	123,551	\$5,876	\$22,783
Services	538,104	\$27,276	\$34,497
Other	13,311	\$1,004	\$850
Total Economic Impact	9,160,566	\$533,548	\$1,081,701

Source: PwC calculations using the IMPLAN modeling system (2009 database).

Details may not add to totals due to rounding.

* Employment is defined as the number of payroll and self-employed jobs, including part-time jobs.

** Labor income is defined as wages and salaries and benefits as well as proprietors' income.

Table ES1: Estimated Economic Impacts of Developing the Marcellus Shale

<i>Assumptions</i>	<i>Low Development*</i> (<i>E</i> = 0.5, <i>R/W</i> = 1.5 bcf)			<i>Medium Development</i> (<i>E</i> = 1.0, <i>R/W</i> = 2.0 bcf)			<i>High Development**</i> (<i>E</i> = 2.7, <i>R/W</i> = 2.8 bcf)		
	<u>2011</u>	<u>2015</u>	<u>2020</u>	<u>2011</u>	<u>2015</u>	<u>2020</u>	<u>2011</u>	<u>2015</u>	<u>2020</u>
	<i>Number of Wells</i>								
<i>Wells Drilled</i>	1,447	1,605	1,738	2,436	2,970	3,216	2,727	3,918	4,842
	<i>Million cubic feet per day</i>								
<i>NG Output</i>	1,581	2,734	4,036	2,178	6,015	9,519	2,986	10,173	18,212
	<i>Millions of 2010 dollars</i>								
<i>Value Added</i>	6,329	7,835	8,788	10,424	14,166	16,247	11,952	18,833	24,798
	<i>Millions of 2010 dollars</i>								
<i>S&L Taxes</i>	652	822	945	1,063	1,530	1,814	1,243	2,134	2,991
	<i>Millions of 2010 dollars</i>								
<i>Fed. Taxes</i>	821	1,017	1,140	1,355	1,858	2,128	1,551	2,467	3,245
	<i>Number of Jobs</i>								
<i>Employment</i>	72,160	90,120	101,975	118,078	158,408	184,007	135,939	211,683	282,716

E = price elasticity of drilling, R/W = reserves per well,

* Assumes 30% reductions in Pennsylvania and West Virginia drilling during 2011 from 2010 levels.

** Uses survey estimate for planned spending in Pennsylvania in 2011

Table 14: Estimated Future Economic Impacts under Three Development Scenarios

<i>Assumptions</i>	<i>Low Development*</i> (<i>E = 0.5, R/W = 1.5 bcf</i>)			<i>Medium Development</i> (<i>E = 1.0, R/W = 2.0 bcf</i>)			<i>High Development**</i> (<i>E = 2.7, R/W = 2.8 bcf</i>)		
	<i>2011</i>	<i>2015</i>	<i>2020</i>	<i>2011</i>	<i>2015</i>	<i>2020</i>	<i>2011</i>	<i>2015</i>	<i>2020</i>
<i>Wells Drilled</i>	<i>Number of Wells</i>								
NY	0	0	0	42	314	340	52	406	502
PA	1,220	1,353	1,465	2,019	2,239	2,424	2,211	2,903	3,587
WVA	227	252	273	376	417	452	464	609	752
Total	1,447	1,605	1,738	2,436	2,970	3,216	2,727	3,918	4,842
<i>NG Output</i>	<i>Million cubic feet per day</i>								
NY	0	0	0	0	488	952	0	853	1,839
PA	1,353	2,246	3,360	1,802	4,579	7,161	2,522	7,607	13,457
WVA	227	488	677	376	948	1,406	464	1,713	2,916
Total	1,581	2,734	4,036	2,178	6,015	9,519	2,986	10,173	18,212
<i>Value Added</i>	<i>Millions of 2010 dollars</i>								
NY	0	0	0	153	1,705	1,941	171	2,250	2,910
PA	5,510	6,957	7,744	8,940	10,984	12,508	10,129	14,415	18,853
WVA	819	877	1,044	1,331	1,478	1,798	1,652	2,168	3,035
Total	6,329	7,835	8,788	10,424	14,166	16,247	11,952	18,833	24,798
<i>S&L Taxes</i>	<i>Millions of 2010 dollars</i>								
NY	0	0	0	19	214	246	22	283	369
PA	538	688	770	870	1,078	1,239	987	1,417	1,872
WVA	114	134	176	173	237	329	221	377	600
Total	652	822	945	1,063	1,530	1,814	1,243	2,134	2,991
<i>Fed. Taxes</i>	<i>Millions of 2010 dollars</i>								
NY	0	0	0	21	239	272	24	316	407
PA	724	913	1,016	1,176	1,443	1,641	1,332	1,893	2,473
WVA	97	104	125	158	176	215	196	259	364
Total	821	1,017	1,140	1,355	1,858	2,128	1,551	2,467	3,245
<i>Employment</i>	<i>Number of Jobs</i>								
NY	0	0	0	1,419	15,727	18,027	1,598	20,803	27,060
PA	60,755	77,788	87,119	98,222	121,816	140,169	111,413	160,205	211,909
WVA	11,405	12,332	14,856	18,437	20,864	25,810	22,928	30,675	43,746
Total	72,160	90,120	101,975	118,078	158,408	184,007	135,939	211,683	282,716

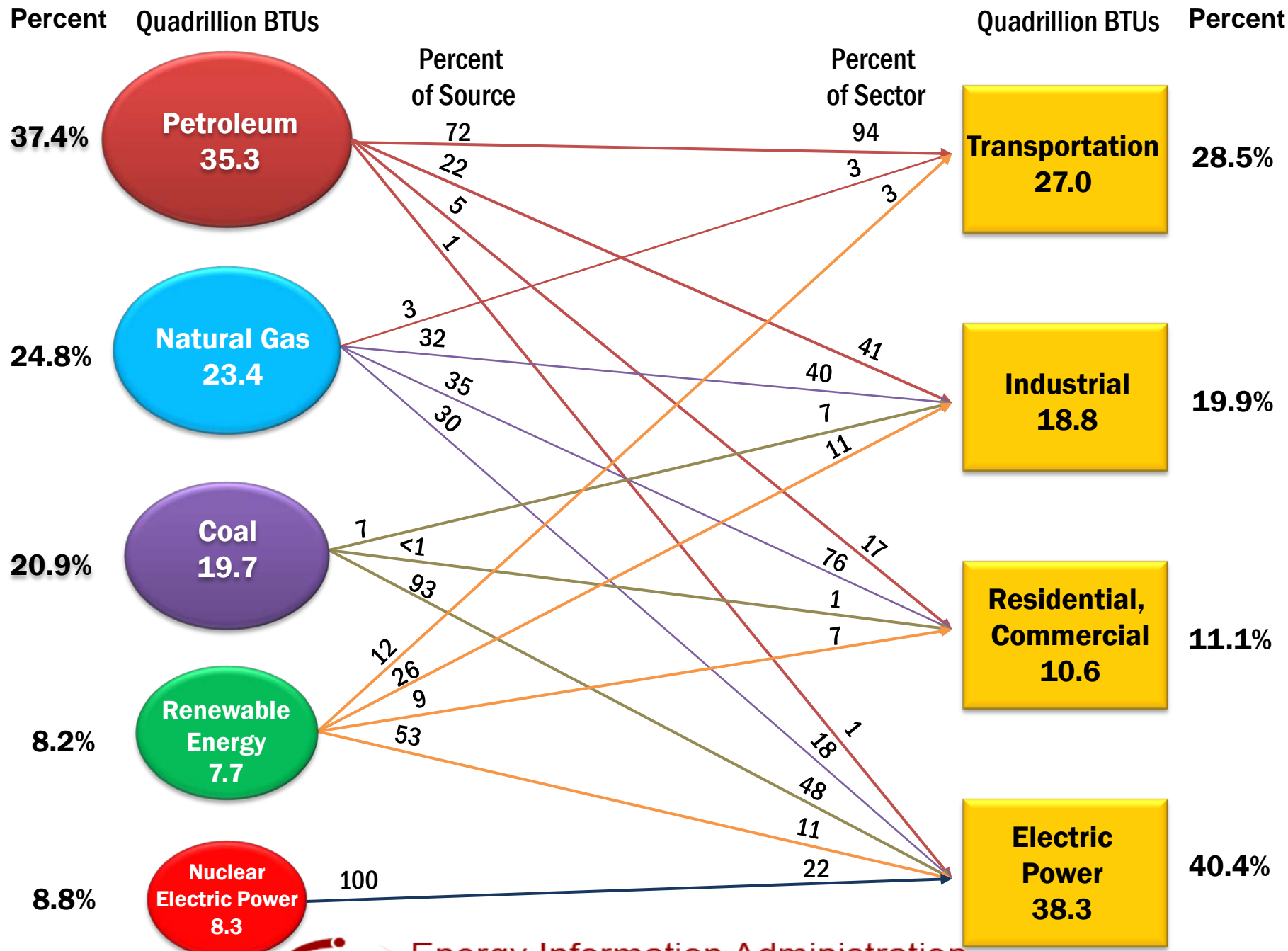
Economic Impact of Marcellus Shale on West Virginia

	2009	2011	2015	2020
Employment	13,249	11,405 – 22,298	12,332 - 30,675	14,856 – 43,746
Value Added (millions)	\$939	\$819 - \$1,652	\$877 - \$2,168	\$1,044 - \$3,035
State & Local Taxes (millions)	\$110	\$114 - \$221	\$134 - \$377	\$176 - \$600
Federal Taxes (millions)	\$111	\$97 - \$196	\$104 - \$259	\$125 - \$364

Source: Timothy J. Considine, “The Economic Impacts of the Marcellus Shale: Implications for New York, Pennsylvania and West Virginia,” July 2010

Table 8: Estimated Employment Impacts in West Virginia in 2009

Sector	Number of Jobs			
	Direct	Indirect	Induced	Total
Ag, Forestry, Fish & Hunting	59	11	9	79
Mining	1,020	10	1	1,032
Utilities	43	21	17	81
Construction	1,805	44	24	1,873
Manufacturing	24	49	10	83
Wholesale Trade	1,013	142	84	1,240
Retail trade	1,149	73	625	1,847
Transportation & Warehousing	209	122	35	366
Information	32	87	38	158
Finance & Insurance	65	164	125	353
Real estate & rental	168	157	121	446
Professional- scientific & tech services	322	454	86	862
Management of companies	0	48	6	53
Administrative & waste services	151	325	88	564
Educational services	271	4	63	339
Health & social services	848	9	712	1,569
Arts- entertainment & recreation	110	18	63	191
Hotel & food services	482	132	330	944
Other services	417	123	288	829
Government & Misc.	248	58	36	342
Total	8,436	2,052	2,762	13,249





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