marginal wells:
fuel for economic growth

2012 report

INTERSTATE
Oil & Gas
COMPACT COMMISSION

about the Interstate Oil and Gas Compact Commission

The Interstate Oil and Gas Compact Commission is a multi-state government agency that promotes the conservation and efficient recovery of our nation's oil and natural gas resources while protecting health, safety and the environment. The IOGCC consists of the governors of 38 states (30 members and eight associate states) that produce most of the oil and natural gas in the United States. Chartered by Congress in 1935, the organization is the oldest and largest interstate compact in the nation. The IOGCC assists states in balancing interests through sound regulatory practices. These interests include: maximizing domestic oil and natural gas production, minimizing the waste of irreplaceable natural resources, and protecting human and environmental health. The IOGCC also provides an effective forum for government, industry, environmentalists and others to share information and viewpoints, allowing members to take a proactive approach to emerging technologies and environmental issues. For more information visit iogcc.ok.gov or call (405) 525-3556.


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introduction

For nearly 80 years, the Interstate Oil and Gas Compact Commission (IOGCC) has championed the preservation of this country's low-volume, marginal wells and documented their production. The IOGCC recognizes that it goes to the heart of conservation values to do all that is possible to productively recover the scarce oil and natural gas resources marginal wells produce.

The IOGCC defines a marginal well as a well that produces 10 barrels of oil or 60 Mcf of natural gas per day or less. Generally, these wells started their productive life producing much greater volumes using natural pressure. Over time, the pressure decreases and production drops. That is not to say that the reservoirs which feed the wells are necessarily depleted. It has been estimated that in many cases marginal wells may be accessing a reservoir that stills holds two-thirds of its potential value.

However, because these resources are not always easily or economically accessible, many of the marginal wells in the United States are at risk of being prematurely abandoned, leaving large quantities of oil or gas behind.

In addition to supplying much-needed energy, marginal wells are important to communities across the country, providing jobs and driving economic activity. Today, as the nation ponders the solution to its energy challenges, the commission continues to tell the story of how tiny producing wells can collectively contribute to a sound energy and economic future.

definitions

Marginal Well. A producing well that requires a higher price per Mcf or per barrel of oil to be worth producing, due to low production rates and/ or high production costs from its location (e.g. far offshore; in deep waters; onshore far from good roads for oil pickup and no pipeline) and/or its high co-production of substances that must be separated out and disposed of (e.g. saline water, non-burnable gasses mixed with the natural gas). A Marginal Well becomes unprofitable to produce whenever oil and/or gas prices drop below its crucial profit point. On land, this is often but not always a stripper well.

Stripper Well. An oil well whose maximum daily average oil production does not exceed 10 bbls oil per day during any consecutive 12 month period. Often used interchangeably with the term "Marginal Well", although they are not the same.

Temporary Abandonment. "Cessation of work on a well pending determination of whether it should be completed as a producer or permanently abandoned." (Williams & Meyers)

Idle Well. (1) A well that is not producing or injecting, and has received state approval to remain idle or (2) a well that is not producing or injecting, has not received state approval to remain idle, and for which the operator is known or solvent.
(IOGCC)

Plugged and Abandoned. Wells that have had plugging operations during the calendar year. Does not include wells that have been plugged back up-hole in order to kick the well, etc. This category does not necessarily exclude those with site restoration remaining to be completed.

ECONOMIC IMPLICATIONS

of renewed growth in the U.S. oil and natural gas industry

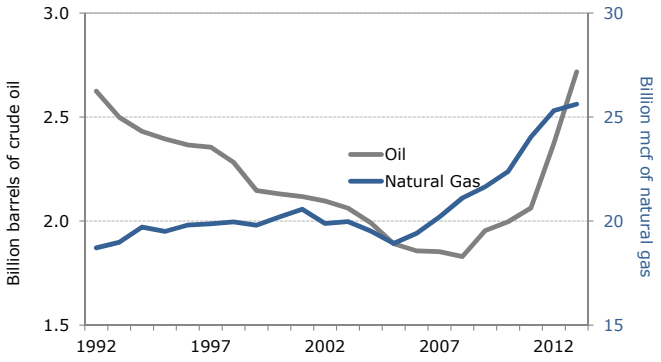
The United States is now at the epicenter of what began as a natural gas boom a decade ago and has since become a dynamic revival of the domestic oil and natural gas industry and its supply-chain. New technologies and advanced drilling techniques have helped reestablish the prominence of the U.S. energy industry on the international stage. The U.S. Energy Information Administration (EIA) estimates that the United States will become the world's top producer of petroleum and natural gas hydrocarbons in 2013, moving ahead of both Russia and Saudi Arabia. [1]

Technology and Advanced Drilling Boost Domestic Oil and Gas Output

The sharp rebound in U.S. oil and natural gas output in recent years is traced almost fully to the industry's transition to unconventional methods of hydrocarbon production and the integration of new drilling technologies. These new technologies include modern seismic imaging, advances in horizontal and directional drilling, and new unconventional production techniques in shale and tight formations, including hydraulic fracturing. Along with opening new fields, the shift to modern drilling techniques and unconventional production has revitalized many of the nation's legacy oil and natural gas fields written off long ago as economically marginal.

Recent estimates indicate that domestic oil production reached 2.8 billion barrels in 2013, a more than 50 percent increase since 2008 and the highest level of domestic production since 1989 (see Figure 1). Natural gas output is similarly up nearly 50 percent since 2005 to more than 25.6 billion Mcf in 2013, an all-time high in domestic production.

FIGURE 1. U.S. OIL AND NATURAL GAS PRODUCTION



Source: U.S. EIA

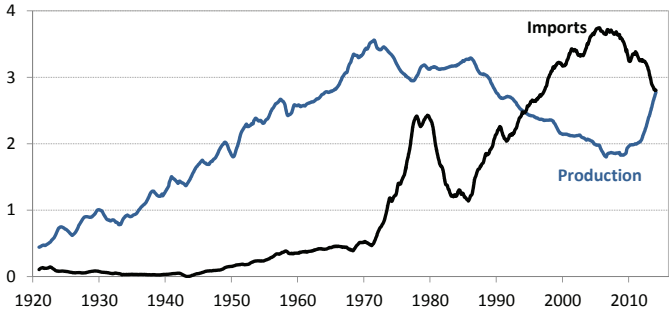
The industry's resurgence is providing a much needed boost to the U.S. economy. In the decade from 2002 to 2012, total gross domestic product (GDP) produced by the oil and gas industry increased by 42 percent, the second largest gain among major NAICS industry groups behind only the information sector. The total market value of oil and gas produced by the industry is up more than three-fold the past decade and employment has roughly doubled.

Considerable progress made toward reducing oil imports

Strong growth in domestic oil production since 2008 has helped reduce the reliance of the U.S. economy on imported oil and push the nation much closer to petroleum independence. In early 2014, domestic oil production exceeded imports for the first time after more than two decades of rapidly increasing imports (see Figure 2). Total U.S. oil production is up nearly 1 billion barrels at an annual rate since 2008, while imports have fallen by approximately the same 1 billion barrels annually.

FIGURE 2. U.S. OIL PRODUCTION AND IMPORTS

Billions of Barrels - 12 month total



Source: U.S. EIA

The reduction in imports has altered overall U.S. trade patterns and reversed a significant financial outflow to other producing countries. At approximately $100 per barrel, the market value of the 1 billion barrel shift from imported to domestically produced oil is roughly $100 billion annually. This large ongoing financial outflow has been redirected back to U.S. production to support domestic employment and earnings.

Exports of petroleum products have surged along with the rebound in U.S. oil production. Petroleum exports have roughly doubled since 2009, from 700 million barrels annually to nearly 1.4 billion barrels in 2013. Natural gas has similarly moved to the forefront as a potential export product as rapid progress continues across the country on the construction of LNG export facilities.

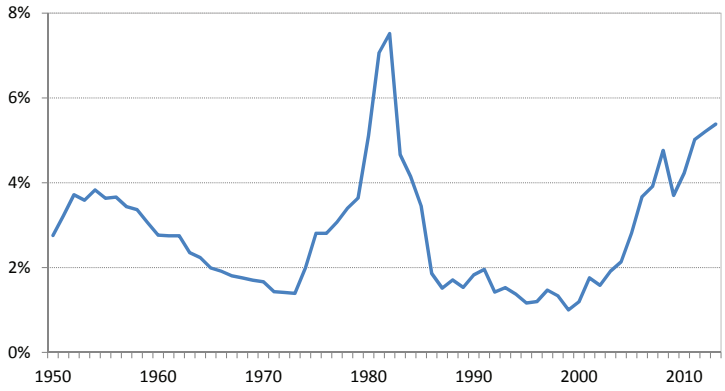
Potentially more important than the improved U.S. trade balance, the reemergence of the industry has important implications for international trade policy as it relates to national security.

Drilling investment rises as a share of total business investment

The effects of a revitalized domestic oil and gas industry are most visible in the ongoing surge in drilling and exploration activity taking place across the nation. The combination of new technologies and advanced drilling techniques has greatly increased the number of economically viable drilling opportunities.

Investment spending by the mining sector on exploration, shafts, and wells is now more than $140 billion annually. This is almost double the investment spending on computers and peripheral equipment after being roughly equal as recently as 2010.[2] Oil and gas investment spending has surged to nearly 5.5 percent of total private nonresidential investment in the United States (see Figure 3) and is approaching the 7.5 percent share reached at the peak of drilling activity in 1982.

FIGURE 3. MINING SHARE OF PRIVATE FIXED NONRESIDENTIAL INVESTMENT



Source: U.S. EIA

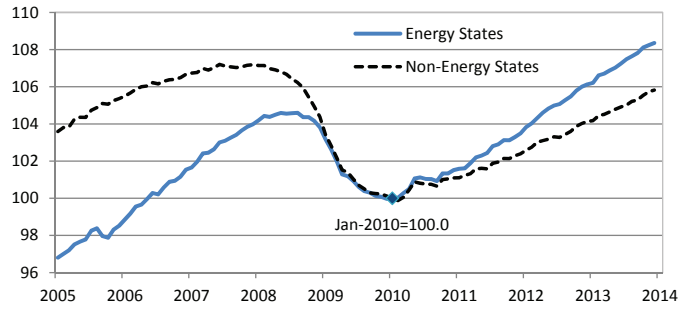
More importantly, the economic payoff in the nation's drilling regions from increased exploration and drilling activity is now much larger from an economic impact point of view than in prior years. The process of drilling a modern unconventional well is now considerably more capital intensive and a much more significant economic event. Horizontally drilled and hydraulically fractured wells typically cost between $3 million and $12 million to complete, and a greater share of the lifetime production of a well occurs in the early years of the well's life. This considerably accelerates the expected flow of revenues, royalties, and tax payments from a modern well relative to drilling a conventional well of only a few years ago. The increased economic weight carried by current drilling and exploration activity suggests added potential opportunity to influence overall U.S. economic activity going forward.

Energy-producing states add jobs at a faster pace than non-energy states

The resurgence in domestic oil and natural gas activity is having highly visible effects on hiring, particularly in the traditional energy-producing states. [3] The economies of these states remain sensitive to changes in oil and natural gas prices and tend to follow a much different economic cycle than the non-energy states. The energy sector can sway the overall economy of these states because of the highly capital intensive nature of the industry and the strength of the economic linkages between the energy and non-energy sectors. And as export-oriented goods, oil and natural gas often serve as key economic base products that attract spending from outside the state.

Figure 4 illustrates the stronger overall pace of hiring in the energy-producing states versus the non-energy states the past decade. Prior to the recession, the energy states posted faster job growth and entered the recession much later and with more momentum than the non-energy states. The energy states provided much needed support to the labor market during the recession and posted smaller cumulative job losses in the downturn. Since early 2010 when hiring resumed nationally, the energy states have consistently posted much faster job growth than the non-energy states. In fact, the oil and natural gas industry produced nearly 200,000 new wage and salary jobs in the U.S. from early 2010 through 2013, a 7.8 percent annual growth rate. This is the fastest rate of job growth among the major NAICS industry sectors in the period and has resulted in some of the highest quality 'mid-tier' and 'skilled' employment opportunities available across the country.

FIGURE 4. JOB GROWTH – ENERGY VS. NON-ENERGY STATES



The energy states include AK, LA, MI, OK, TX, CO, MT, NM, UT, WY, KS, ND, and WV.

Source: Bureau of Labor Statistics, RegionTrack

Rising domestic production spurs capacity additions and restructuring of the U.S. pipeline infrastructure

Rising domestic production of oil and natural gas has propelled major pipeline development across the nation.

Recent major additions to the U.S. oil pipeline network include the TransCanada Keystone pipeline from Steele City, Nebraska to Cushing, Oklahoma and the Gulf Coast Express from

Cushing to the Gulf. Other major oil pipeline additions are targeted at improving the flow of oil from the fast-growing Bakken formation in North Dakota and the long-standing Permian Basin in Texas, two areas that are vital to the ongoing expansion of U.S. oil production. Existing oil pipelines such as the Pegasus have had their flow reversed in order to better match product demand across the country. Other innovative expansion projects include the Pony Express pipeline, anticipated to be completed in late 2014, that will add new oil capacity out of the Bakken using a combination of new pipeline and a converted natural gas line.

On the natural gas side, EIA reports that 528 projects[4] to either add new pipeline or expand existing natural gas pipelines were completed in the decade between 2003 and 2013. Investments in these projects totaled more than $35 billion and added nearly 8,200 miles of new intra- and interstate natural gas pipeline. An additional 53 natural gas projects are announced or approved for completion by 2016.

MARGINAL OIL

Table 3. National Marginal Oil Well Survey (2012)

State	Number of Marginal Oil Wells	Production from Marginal Wells (Bbls)	Average Daily Production per Well (Bbls)	Total Oil Production (Bbls)	Marginal Share of Total Production
Alabama	701	897,436	3.5	9,515,760	9.4%
Alaska	0	0	0.0	192,368,220	0.0%
Arizona	16	18,617	3.2	51,949	35.8%
Arkansas	4,387	3,123,544	2.0	6,535,000	47.8%
California	34,682	42,489,801	3.4	197,552,992	21.5%
Colorado	10,245	9,296,101	2.5	49,289,955	18.9%
Illinois	27,479	9,796,000	1.0	9,796,000	100.0%
Indiana	3,399	1,880,028	1.5	2,350,035	80.0%
Kansas	20,565	16,596,500	2.2	43,675,000	38.0%
Kentucky	26,424	2,705,474	0.3	3,198,000	84.6%
Louisiana	16,679	9,851,323	1.6	70,649,388	13.9%
Maryland	-	-	-	-	-
Michigan	2,375	3,100,000	3.6	7,410,802	41.8%
Mississippi	1,000	1,366,348	3.7	24,137,573	5.7%
Missouri	425	173,000	1.1	173,000	100.0%
Montana	2,843	2,181,923	2.1	26,495,000	8.2%
Nebraska	1,553	1,545,886	2.7	2,513,356	61.5%
Nevada	36	58,230	4.4	368,000	15.8%
New Mexico	15,914	15,816,600	2.7	84,657,398	18.7%
New York	3,386	347,780	0.3	352,049	98.8%
North Dakota	1,656	2,482,018	4.1	243,246,417	1.0%
Ohio	28,204	3,885,815	0.4	4,974,359	78.1%
Oklahoma	31,460	16,103,475	1.4	89,053,000	18.1%
Pennsylvania	22,430	2,055,072	0.3	2,349,255	87.5%
South Dakota	28	45,090	4.4	1,754,208	2.6%
Texas	142,726	114,190,108	2.2	592,437,753	19.3%
Utah	2,347	3,487,001	4.1	30,184,634	11.6%
Virginia	3	159	0.1	9,659	1.6%
West Virginia	4,386	829,013	0.5	2,591,306	32.0%
Wyoming	4,244	4,384,106	2.8	57,554,213	7.6%
Survey States	409,593	268,706,448	1.8	1,562,876,061	17.2%

State Rankings - Marginal Crude Oil (2012)

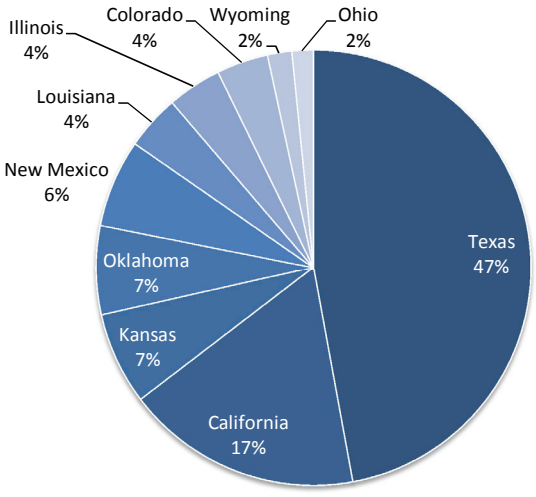
State	Number of Marginal Oil Wells
Texas	142,726
California	34,682
Oklahoma	31,460
Ohio	28,204
Illinois	27,479
Kentucky	26,424
Pennsylvania	22,430
Kansas	20,565
Louisiana	16,679
New Mexico	15,914
Colorado	10,245
Arkansas	4,387
West Virginia	4,386
Wyoming	4,244
Indiana	3,399
New York	3,386
Montana	2,843
Michigan	2,375
Utah	2,347
North Dakota	1,656
Nebraska	1,553
Mississippi	1,000
Alabama	701
Missouri	425
Nevada	36
South Dakota	28
Arizona	16
Virginia	3
Maryland	-
Survey States	409,593

State	Production from Marginal Wells (Bbls)
Texas	114,190,108
California	42,489,801
Kansas	16,596,500
Oklahoma	16,103,475
New Mexico	15,816,600
Louisiana	9,851,323
Illinois	9,796,000
Colorado	9,296,101
Wyoming	4,384,106
Ohio	3,885,815
Utah	3,487,001
Arkansas	3,123,544
Michigan	3,100,000
Kentucky	2,705,474
North Dakota	2,482,018
Montana	2,181,923
Pennsylvania	2,055,072
Indiana	1,880,028
Nebraska	1,545,886
Mississippi	1,366,348
Alabama	897,436
West Virginia	829,013
New York	347,780
Missouri	173,000
Nevada	58,230
South Dakota	45,090
Arizona	18,617
Virginia	159
Maryland	-
Survey States	268,706,448

State	Marginal Share of Total Production
Illinois	100.0%
Missouri	100.0%
New York	98.8%
Pennsylvania	87.5%
Kentucky	84.6%
Indiana	80.0%
Ohio	78.1%
Nebraska	61.5%
Arkansas	47.8%
Michigan	41.8%
Kansas	38.0%
Arizona	35.8%
West Virginia	32.0%
California	21.5%
Texas	19.3%
Colorado	18.9%
New Mexico	18.7%
Oklahoma	18.1%
Nevada	15.8%
Louisiana	13.9%
Utah	11.6%
Alabama	9.4%
Montana	8.2%
Wyoming	7.6%
Mississippi	5.7%
South Dakota	2.6%
Virginia	1.6%
North Dakota	1.0%
Maryland	-
Survey States	17.2%

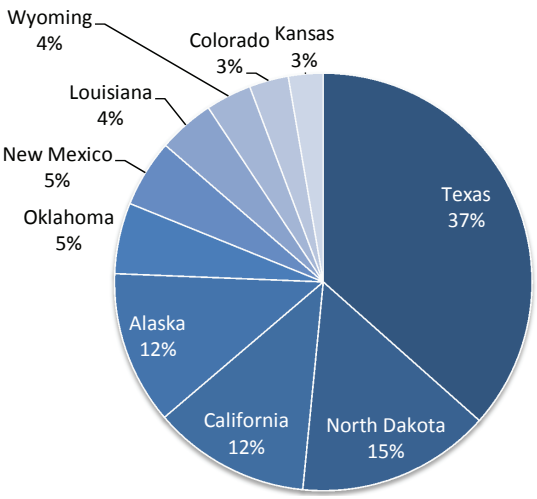
State	Average Daily Production per Well (Bbls)
Nevada	4.4
South Dakota	4.4
North Dakota	4.1
Utah	4.1
Mississippi	3.7
Michigan	3.6
Alabama	3.5
California	3.4
Arizona	3.2
Wyoming	2.8
Nebraska	2.7
New Mexico	2.7
Colorado	2.5
Kansas	2.2
Texas	2.2
Montana	2.1
Arkansas	2.0
Louisiana	1.6
Indiana	1.5
Oklahoma	1.4
Missouri	1.1
Illinois	1.0
West Virginia	0.5
Ohio	0.4
New York	0.3
Kentucky	0.3
Pennsylvania	0.3
Virginia	0.1
Maryland	-
Survey States	1.8

Top 10 in Marginal Oil Production



State	Total Oil Production (Bbls)
Texas	592,437,753
North Dakota	243,246,417
California	197,552,992
Alaska	192,368,220
Oklahoma	89,053,000
New Mexico	84,657,398
Louisiana	70,649,388
Wyoming	57,554,213
Colorado	49,289,955
Kansas	43,675,000

Top 10 in Total Oil Production



Comparative number of marginal oil wells and marginal oil well production 2008 - 2012

State	2008		2009	
	Number of Marginal Oil Wells	Production from Marginal Wells (Bbls)	Number of Marginal Oil Wells	Production from Marginal Wells (Bbls)
Alabama	680	1,009,774	693	951,704
Arizona	16	22,514	16	19,637
Arkansas	4,123	3,075,053	4,547	3,005,944
California	31,255	40,600,275	31,984	40,702,381
Colorado	4,289	3,734,540	8,380	9,180,045
Illinois	25,635	9,448,000	26,649	9,097,000
Indiana	4,355	1,672,479	4,526	1,803,982
Kansas	17,791	15,316,817	18,061	15,563,714
Kentucky	18,576	2,178,114	25,259	2,579,940
Louisiana	16,102	11,779,256	19,969	18,554,005
Maryland	-	-	-	-
Michigan	2,315	3,089,050	2,290	3,046,215
Mississippi	1,000	1,094,205	954	881,198
Missouri	-	-	-	-
Montana	2,645	2,085,300	2,640	2,006,412
Nebraska	1,471	1,644,062	1,463	1,434,068
Nevada	37	58,863	32	59,409
New Mexico	15,385	15,235,619	15,570	15,232,596
New York	3,442	397,060	3,339	323,536
North Dakota	1,509	2,406,132	1,532	2,310,151
Ohio	29,255	5,076,571	29,340	4,399,562
Oklahoma	34,985	23,799,316	33,967	21,389,976
Pennsylvania	19,093	2,996,000	19,307	2,964,000
South Dakota	27	47,993	-	-
Texas	132,297	107,160,693	134,602	108,067,592
Utah	1,611	2,638,738	1,775	2,775,796
Virginia	3	1,402	2	1,095
West Virginia	3,617	679,134	3,647	833,747
Wyoming	4,063	4,196,568	3,468	3,930,281
Survey States	375,577	261,443,528	394,012	271,113,986

2010		2011		2012	
Number of Marginal Oil Wells	Production from Marginal Wells (Bbls)	Number of Marginal Oil Wells	Production from Marginal Wells (Bbls)	Number of Marginal Oil Wells	Production from Marginal Wells (Bbls)
694	710,257	678	876,930	701	897,436
19	17,949	16	16,943	16	18,617
4,378	2,986,944	4,393	3,127,385	4,387	3,123,544
32,873	40,935,152	34,682	42,489,801	34,682	42,489,801
8,786	8,486,967	9,522	9,393,977	10,245	9,296,101
25,440	9,069,000	25,903	9,234,000	27,479	9,796,000
3,386	1,468,234	3,371	1,589,825	3,399	1,880,028
18,498	15,860,809	19,068	16,265,900	20,565	16,596,500
25,881	2,131,398	26,120	1,967,708	26,424	2,705,474
20,041	19,424,135	19,274	20,977,684	16,679	9,851,323
-	-	-	-	-	-
2,320	3,292,050	2,386	3,020,100	2,375	3,100,000
959	1,287,508	1,030	1,348,460	1,000	1,366,348
482	146,833	439	112,508	425	173,000
2,724	2,110,892	2,783	2,146,408	2,843	2,181,923
1,452	1,407,979	1,516	1,596,257	1,553	1,545,886
32	51,945	35	57,189	36	58,230
15,689	15,400,478	15,945	15,274,557	15,914	15,816,600
3,710	380,846	3,568	374,363	3,386	347,780
1,602	2,499,486	1,579	2,264,924	1,656	2,482,018
29,332	4,170,336	29,334	4,135,696	28,204	3,885,815
32,044	16,713,472	31,752	16,408,474	31,460	16,103,475
22,196	2,245,524	22,562	2,217,506	22,430	2,055,072
28	43,751	30	48,673	28	45,090
135,089	109,018,375	139,737	110,814,436	142,726	114,190,108
1,935	3,037,130	2,140	3,342,926	2,347	3,487,001
3	376	3	305	3	159
3,714	781,230	3,779	753,366	4,386	829,013
3,868	4,092,673	3,856	4,048,670	4,244	4,384,106
397,175	267,771,730	405,501	273,904,970	409,593	268,706,448

MARGINAL GAS

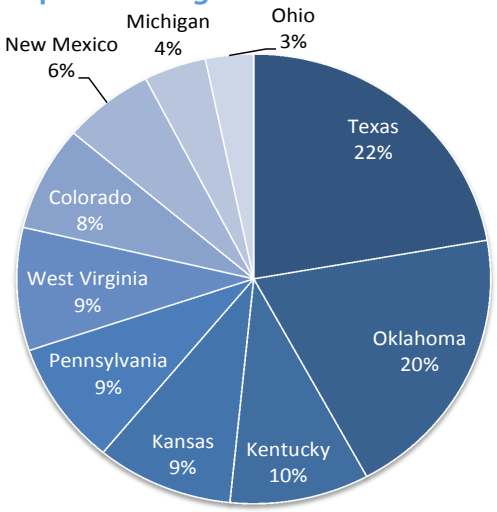
Table 4. National Marginal Gas Well Survey (2012)

State	Number of Marginal Gas Wells	Production from Marginal Wells (Mcf)	Average Daily Production per Well (Mcf)	Total Gas Production (Mcf)	Marginal Share of Total Production
Alabama	4,582	51,296,788	30.7	216,905,694	23.6%
Alaska	0	0	0.0	108,510,876	0.0%
Arizona	2	17,512	24.0	116,560	15.0%
Arkansas	3,681	26,447,304	19.7	1,146,168,000	2.3%
California	833	6,880,384	22.6	249,373,055	2.8%
Colorado	16,171	142,461,921	24.1	1,707,125,982	8.3%
Illinois	1,054	265,073	0.7	2,125,000	12.5%
Indiana	419	7,932,487	51.9	8,813,874	90.0%
Kansas	17,826	176,400,560	27.1	298,984,000	59.0%
Kentucky	18,355	179,419,019	26.8	278,462,314	64.4%
Louisiana	15,118	59,808,791	10.8	2,876,819,270	2.1%
Maryland	7	31,186	12.2	31,186	100.0%
Michigan	7,967	80,200,240	27.6	129,358,956	62.0%
Mississippi	1,567	1,158,549	2.0	56,259,601	2.1%
Missouri	4	35,000	24.0	35,000	100.0%
Montana	6,242	39,211,338	17.2	66,954,000	58.6%
Nebraska	291	1,220,867	11.5	1,220,867	100.0%
Nevada	-	-	-	-	-
New Mexico	13,867	117,374,597	23.2	1,251,237,600	9.4%
New York	6,963	11,257,580	4.4	26,423,911	42.6%
North Dakota	200	875,315	12.0	258,933,917	0.3%
Ohio	32,360	61,941,296	5.2	86,770,137	71.4%
Oklahoma	31,202	373,851,262	32.8	1,883,204,000	19.9%
Pennsylvania	67,556	167,358,869	6.8	2,259,769,718	7.4%
South Dakota	85	361,999	11.7	15,108,221	2.4%
Texas	54,651	419,502,886	21.0	8,024,741,449	5.2%
Utah	2,423	25,457,931	28.8	490,691,929	5.2%
Virginia	1,582	13,585,477	23.5	146,130,998	9.3%
West Virginia	51,678	166,595,970	8.8	541,570,080	30.8%
Wyoming	4,955	38,878,967	21.5	2,245,230,966	1.7%
Survey States	361,641	2,169,829,168	16.4	24,268,566,285	8.9%

State Rankings - Marginal Crude Gas (2012)

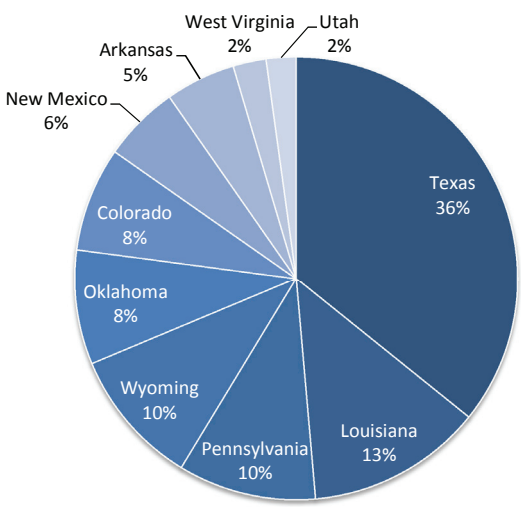
State	Number of Marginal Gas Wells	State	Production from Marginal Gas Wells (Mcf)	State	Marginal Share of Total Gas Production	State	Average Daily Production per Well (Mcf)
Pennsylvania	67,556	Texas	419,502,886	Nebraska	100.0%	Indiana	51.9
Oklahoma	60,415	Oklahoma	290,272,123	Maryland	100.0%	Alabama	30.7
Texas	54,651	Kentucky	179,419,019	Missouri	100.0%	Utah	28.8
West Virginia	51,678	Kansas	176,400,560	Indiana	90.0%	Michigan	27.6
Ohio	32,360	Pennsylvania	167,358,869	Ohio	71.4%	Kansas	27.1
Kentucky	18,355	West Virginia	166,595,970	Kentucky	64.4%	Kentucky	26.8
Kansas	17,826	Colorado	142,461,921	Michigan	62.0%	Colorado	24.1
Colorado	16,171	New Mexico	117,374,597	Kansas	59.0%	Arizona	24.0
Louisiana	15,118	Michigan	80,200,240	Montana	58.6%	Missouri	24.0
New Mexico	13,867	Ohio	61,941,296	New York	42.6%	Virginia	23.5
Michigan	7,967	Louisiana	59,808,791	West Virginia	30.8%	New Mexico	23.2
New York	6,963	Alabama	51,296,788	Alabama	23.6%	California	22.6
Montana	6,242	Montana	39,211,338	Oklahoma	15.4%	Wyoming	21.5
Wyoming	4,955	Wyoming	38,878,967	Arizona	15.0%	Texas	21.0
Alabama	4,582	Arkansas	26,447,304	Illinois	12.5%	Arkansas	19.7
Arkansas	3,681	Utah	25,457,931	New Mexico	9.4%	Montana	17.2
Utah	2,423	Virginia	13,585,477	Virginia	9.3%	Oklahoma	13.2
Virginia	1,582	New York	11,257,580	Colorado	8.3%	Maryland	12.2
Mississippi	1,567	Indiana	7,932,487	Pennsylvania	7.4%	North Dakota	12.0
Illinois	1,054	California	6,880,384	Texas	5.2%	South Dakota	11.7
California	833	Nebraska	1,220,867	Utah	5.2%	Nebraska	11.5
Indiana	419	Mississippi	1,158,549	California	2.8%	Louisiana	10.8
Nebraska	291	North Dakota	875,315	South Dakota	2.4%	West Virginia	8.8
North Dakota	200	South Dakota	361,999	Arkansas	2.3%	Pennsylvania	6.8
South Dakota	85	Illinois	265,073	Louisiana	2.1%	Ohio	5.2
Maryland	7	Missouri	35,000	Mississippi	2.1%	New York	4.4
Missouri	4	Maryland	31,186	Wyoming	1.7%	Mississippi	2.0
Arizona	2	Arizona	17,512	North Dakota	0.3%	Illinois	0.7
Nevada	-	Nevada	-	Nevada	-	Nevada	-
Survey States	390,855	Survey States	2,086,250,029	Survey States	8.6%	Survey States	14.6

Top 10 in Marginal Gas Production



State	Total Gas Production (Mcf)
Texas	8,024,741,449
Louisiana	2,876,819,270
Pennsylvania	2,259,769,718
Wyoming	2,245,230,966
Oklahoma	1,883,204,000
Colorado	1,707,125,982
New Mexico	1,251,237,600
Arkansas	1,146,168,000
West Virginia	541,570,080
Utah	490,691,929

Top 10 in Total Gas Production



Comparative number of marginal gas wells and marginal gas well production 2008 - 2012

State	2008		2009	
	Number of Marginal Gas Wells	Production from Marginal Wells (Mcf)	Number of Marginal Gas Wells	Production from Marginal Wells (Mcf)
Alabama	3,751	40,353,899	4,111	44,241,046
Arizona	3	19,202	2	19,442
Arkansas	2,224	22,067,600	2,448	23,566,824
California	678	5,463,835	730	5,579,765
Colorado	25,826	280,104,854	12,605	122,056,931
Illinois	720	180,000	716	180,000
Indiana	667	2,350,691	520	4,927,163
Kansas	16,487	155,826,509	16,820	167,761,611
Kentucky	17,479	101,362,982	18,722	290,908,001
Louisiana	5,742	50,402,837	10,531	84,396,916
Maryland	7	28,000	7	43,584
Michigan	7,567	88,228,804	7,616	88,462,111
Mississippi	1,192	10,690,535	1,587	12,241,310
Missouri	-	-	-	-
Montana	5,093	34,123,251	5,440	35,401,640
Nebraska	281	2,522,377	334	2,582,986
Nevada	-	-	-	-
New Mexico	12,844	111,383,175	13,247	116,039,736
New York	6,272	12,041,408	6,424	14,015,245
North Dakota	161	1,234,700	169	1,232,507
Ohio	34,412	75,014,485	34,547	72,498,491
Oklahoma	28,062	329,693,635	28,744	333,199,823
Pennsylvania	55,681	165,576,000	56,178	199,052,000
South Dakota	63	363,030	-	-
Texas	46,234	372,260,611	49,038	389,000,000
Utah	1,808	17,530,476	1,925	19,728,150
Virginia	372	2,611,817	1,340	10,754,506
West Virginia	41,123	109,832,150	47,020	219,247,100
Wyoming	7,765	58,696,937	5,929	45,173,845
Survey States	322,514	2,049,963,800	326,750	2,302,310,733

2010		2011		2012	
Number of Marginal Gas Wells	Production from Marginal Wells (Mcf)	Number of Marginal Gas Wells	Production from Marginal Wells (Mcf)	Number of Marginal Gas Wells	Production from Marginal Wells (Mcf)
4,436	45,994,043	4,672	49,102,574	4,582	51,296,788
1	718	2	21,958	2	17,512
2,278	26,474,983	2,292	25,818,362	3,681	26,447,304
783	6,686,416	827	6,755,208	833	6,880,384
13,762	134,860,255	14,897	143,325,079	16,171	142,461,921
845	212,308	1,052	264,574	1,054	265,073
500	6,121,585	421	8,167,631	419	7,932,487
17,336	172,818,311	18,066	178,745,912	17,826	176,400,560
18,162	187,177,263	18,310	157,363,826	18,355	179,419,019
10,602	90,818,048	10,702	89,735,563	15,118	59,808,791
7	45,153	7	41,198	7	31,186
8,036	80,269,338	7,566	89,407,474	7,967	80,200,240
1,587	11,538,922	1,591	1,132,420	1,567	1,158,549
14	56,865	4	32,342	4	35,000
5,683	36,192,093	5,962	37,701,716	6,242	39,211,338
288	2,092,934	297	1,859,439	291	1,220,867
-	-	-	-	-	-
13,583	118,174,528	13,655	117,256,498	13,867	117,374,597
6,479	12,624,809	6,707	12,213,746	6,963	11,257,580
180	1,273,937	190	1,234,675	200	875,315
34,544	63,551,859	34,601	58,521,936	32,360	61,941,296
28,521	326,045,238	29,861	349,948,250	31,202	373,851,262
67,348	224,850,270	64,320	145,179,862	67,556	167,358,869
81	445,113	90	465,941	85	361,999
51,117	404,017,924	53,149	415,370,422	54,651	419,502,886
2,055	21,359,985	2,251	23,064,696	2,423	25,457,931
1,431	10,747,116	1,499	11,891,264	1,582	13,585,477
48,088	172,547,562	51,544	164,134,457	51,678	166,595,970
5,949	44,920,108	6,010	43,863,788	4,955	38,878,967
343,695	2,201,917,684	350,546	2,132,620,811	361,641	2,169,829,168

MARGINAL WELLS

in a revitalized U.S. oil and natural gas industry

"Marginal wells continue to provide a significant share of domestic oil and natural gas output and remain a strategic energy asset for the country. "

The strong growth in domestic production of oil and natural gas in recent years has not diminished the current or expected future role played by marginal wells in the overall U.S. energy production framework. Marginal wells continue to provide a significant share of domestic oil and natural gas output and remain a strategic energy asset for the country. In just the past decade, marginal wells contributed $295 billion of production in the form of 2.9 billion barrels of oil and 18.8 billion Mcf of natural gas.

Maintaining the production from marginal wells has played a key role in keeping mature U.S. oil and natural gas fields active and available for further exploration. Marginal production requires the ongoing use of surface roads for servicing access and the maintenance of local pipelines for distribution. The wide, national footprint of marginal well activity has helped ease the path for new unconventional drilling and exploration activity in most existing fields across the county.

Marginal Well Survey

In order to quantify the ongoing economic contribution of marginal wells in the United States, the IOGCC periodically surveys its member states to acquire data related to marginal well production. The survey results have served as the basis for a long-standing series of reports documenting marginal well activity and the economic contribution of marginal production in the United States. [5]

The current report is based on data collected in the latest IOGCC marginal well survey covering production activity in calendar years 2010, 2011, and 2012. This was a period of dynamic overall growth and extreme energy price volatility for the domestic energy industry.

The survey questionnaire is extensive and collects a range of information on the behavior of marginal oil and natural gas operators across the responding states. Data items include the number of producing wells, type of wells, amounts of marginal and total production, and the number of plugged and abandoned wells.

Twenty-nine states are included in the current marginal wells report as producers of either marginal oil or natural gas, or both. Twenty-seven states submitted extensive responses to the IOGCC survey, while data for two states are either collected from alternative sources or estimated. A few states produced very small amounts of marginal oil or natural gas production in the period but are not included in the report. Even after excluding these very small producers, the twenty-nine states included in the report are believed to represent substantially all of the marginal oil and natural gas produced within the U.S.

While each state receives the same survey questionnaire, the methodology used by the states in defining a marginal well and its associated production can differ. Similarly, the reporting entity within a state and the methods used by a state to derive estimates may also vary over time. Because of the inherent variability in reporting, every effort is made to place all reported data on comparable terms in order to facilitate valid state-to-state and year-to-year comparisons where possible. Where a state's reporting is incomplete, estimates are obtained from reliable alternative sources or formed using statistical-based methods. Appendix A provides a detailed description of the survey responses, alternative data sources, and estimates used in the report.

Table 1. National Marginal Oil Well Survey from 1992 - 2012

Year	Number of Marginal Oil Wells	Production from Marginal Oil Wells (Bbls)	Price of Oil ($/Bbl)	Value of Marginal Oil Production	Average Daily Production per Well (Bbls)
1992	453,277	368,132,000	15.99	5,886,430,680	2.23
1993	452,248	355,961,000	14.25	5,072,444,250	2.16
1994	442,500	339,930,000	13.19	4,483,676,700	2.10
1995	433,048	332,288,089	14.62	4,858,051,861	2.10
1996	428,842	323,468,274	18.46	5,971,224,338	2.06
1997	420,674	323,487,914	17.23	5,573,696,758	2.11
1998	406,380	316,870,286	10.87	3,444,380,009	2.14
1999	410,680	315,514,283	15.56	4,909,402,243	2.10
2000	411,629	325,947,181	26.72	8,709,308,676	2.16
2001	403,459	316,099,192	21.84	6,903,606,353	2.15
2002	402,072	323,776,606	22.51	7,288,211,401	2.21
2003	393,463	313,748,001	27.56	8,646,894,908	2.18
2004	397,362	310,922,122	36.77	11,432,606,426	2.14
2005	401,072	321,761,570	50.28	16,178,171,740	2.20
2006	422,381	324,496,483	59.69	19,369,195,070	2.10
2007	396,537	291,067,592	66.52	19,361,816,220	2.01
2008	375,589	261,627,954	94.04	24,603,492,794	1.91
2009	394,202	275,409,538	56.35	15,519,327,466	1.91
2010	397,175	267,771,730	75.00	20,082,341,296	1.85
2011	405,501	273,904,970	93.76	25,680,839,751	1.85
2012	409,593	268,706,448	93.22	25,047,568,426	1.80

Value of Annual Marginal Production per Well ($)	Oil Wells Plugged/ Abandoned	Total Oil Production (Bbls)	Value of Total Oil Production ($)	Marginal Share of Total Production
12,986	16,211	2,624,632,000	41,967,865,680	14.0%
11,216	16,914	2,499,033,000	35,611,220,250	14.2%
10,133	17,896	2,431,476,000	32,071,168,440	14.0%
11,218	16,389	2,394,268,000	35,004,198,160	13.9%
13,924	16,674	2,366,017,000	43,676,673,820	13.7%
13,249	15,172	2,354,831,000	40,573,738,130	13.7%
8,476	13,912	2,281,919,000	24,804,459,530	13.9%
11,954	11,227	2,146,732,000	33,403,149,920	14.7%
21,158	10,718	2,130,707,000	56,932,491,040	15.3%
17,111	12,234	2,117,511,000	46,246,440,240	14.9%
18,127	13,635	2,096,588,000	47,194,195,880	15.4%
21,976	14,300	2,061,995,000	56,828,582,200	15.2%
28,771	11,977	1,991,404,000	73,223,925,080	15.6%
40,337	11,058	1,891,200,000	95,089,536,000	17.0%
45,857	11,738	1,857,035,000	110,846,419,150	17.5%
48,827	11,639	1,853,122,000	123,269,675,440	15.7%
65,506	7,624	1,829,897,000	172,083,513,880	14.3%
39,369	9,229	1,954,021,000	110,109,083,350	14.1%
50,563	8,374	1,996,787,000	149,755,009,985	13.4%
63,331	9,551	2,063,138,000	193,436,125,970	13.3%
61,152	10,068	2,373,373,000	221,234,819,871	11.3%

Table 2. National Marginal Gas Well Survey from 1992 - 2012

Year	Number of Marginal Gas Wells	Production from Marginal Gas Wells (Mcf)	Price of Natural Gas ($/Mcf)	Value of Marginal Gas Production	Value of Annual Marginal Production per Well ($)
1992	130,432	647,193,099	1.74	1,126,115,993	8,634
1993	142,100	736,683,566	2.04	1,502,834,475	10,576
1994	159,369	940,421,000	1.85	1,739,778,850	10,917
1995	159,669	925,563,034	1.55	1,434,622,703	8,985
1996	168,702	986,676,219	2.17	2,141,087,395	12,692
1997	189,756	1,042,153,002	2.32	2,417,794,965	12,742
1998	199,745	1,104,683,975	1.96	2,165,180,591	10,840
1999	207,766	1,138,979,506	2.19	2,494,365,118	12,006
2000	223,222	1,258,726,664	3.68	4,632,114,124	20,751
2001	234,507	1,353,516,378	4.00	5,414,065,512	23,087
2002	245,961	1,418,273,779	2.95	4,183,907,648	17,010
2003	260,563	1,478,105,524	4.88	7,213,154,957	27,683
2004	271,856	1,539,960,495	5.46	8,408,184,303	30,929
2005	288,898	1,760,063,552	7.33	12,901,265,836	44,657
2006	304,000	1,716,319,702	6.39	10,967,282,896	36,077
2007	322,160	1,763,592,746	6.25	11,022,454,663	34,214
2008	322,507	2,049,935,800	7.97	16,337,988,326	50,659
2009	287,229	2,148,624,539	3.67	7,885,452,058	27,454
2010	343,695	2,201,917,684	4.49	9,879,554,234	28,745
2011	350,546	2,132,620,811	3.95	8,433,783,735	24,059
2012	361,641	2,169,829,168	2.67	5,790,745,282	16,012

Average Daily Production per Well (Mcf)	Gas Wells Plugged/ Abandoned	Total Gas Production (Bbls)	Value of Total Gas Production ($)	Marginal Share of Total Production
13.6	3,161	18,711,808,000	32,558,545,920	3.5%
14.2	3,162	18,981,915,000	38,723,106,600	3.9%
16.2	3,163	19,709,525,000	36,462,621,250	4.8%
15.9	3,189	19,506,474,000	30,235,034,700	4.7%
16.0	4,671	19,812,241,000	42,992,562,970	5.0%
15.0	4,661	19,866,093,000	46,089,335,760	5.2%
15.2	4,203	19,961,348,000	39,124,242,080	5.5%
15.3	3,546	19,804,848,000	43,372,617,120	5.8%
15.4	3,534	20,197,511,000	74,326,840,480	6.2%
15.8	3,600	20,570,295,000	82,281,180,000	6.6%
15.8	3,870	19,884,780,000	58,660,101,000	7.1%
15.5	3,883	19,974,360,000	97,474,876,800	7.4%
15.5	4,129	19,517,491,000	106,565,500,860	7.9%
16.7	4,517	18,927,095,000	138,735,606,350	9.3%
15.5	4,463	19,409,674,000	124,027,816,860	8.8%
15.0	3,331	20,196,346,000	126,227,162,500	8.7%
17.4	3,545	21,112,053,000	168,263,062,410	9.7%
20.5	4,674	21,647,936,000	79,447,925,120	9.9%
17.6	5,569	22,381,873,000	100,422,885,820	9.8%
16.7	6,057	24,036,352,000	95,055,526,767	8.9%
16.4	7,959	25,307,949,000	67,540,748,561	8.6%

U.S. MARGINAL WELL
count and production trends

While the recent surge in domestic production relieved some of the pressure from marginal wells to support domestic energy output, it is unlikely to reduce the expected long-run contribution of marginal production. In fact, an increase in the number of marginally-producing oil and gas wells in the U.S. is anticipated in coming years. Both the sharp increase in the number of wells drilled in recent years and the accelerated production rate associated with modern horizontal wells suggest that another future surge in production from marginal wells is already in the making.

Renewed growth in marginal wells

Tables 1 and 2 provide detailed statistics on annual U.S. marginal oil and natural gas production, respectively, derived from IOGCC marginal well surveys administered for production years 1992 to 2012.

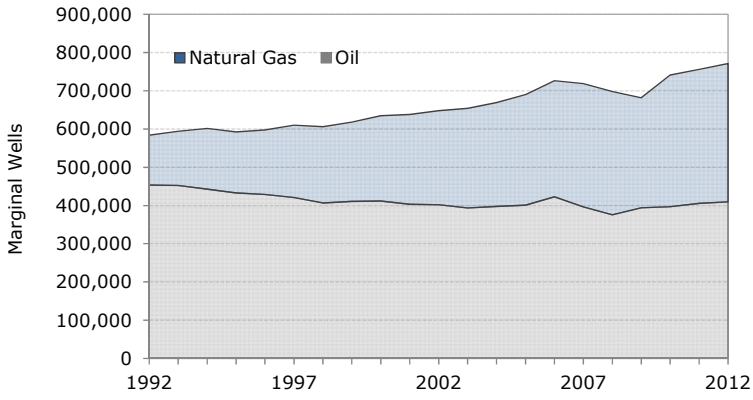
Currently, an estimated 771,000 marginally-producing wells – nearly 410,000 oil wells and more than 361,000 natural gas wells - serve a strategic role within the U.S. energy production framework (see Figure 5).

The total number of producing marginal wells rebounded by more than 13 percent since the last survey in 2009. The reversal ended a multi-year slide in the number of marginal oil wells and marked a resumption of the long-run uptrend in the number of marginal natural gas wells.

Most of the recent increase in the marginal well count is on the natural gas side. The surge in domestic natural gas drilling from 2001 to 2008 under high natural gas prices subsequently produced rapid growth in the number of marginal natural gas wells. The count increased by nearly 75,000 wells between 2009 and 2012 to 361,641, a 26 percent increase. Other than a slowing in 2009 as natural gas prices collapsed, the number of marginal natural gas wells has increased steadily the past two decades.

For oil, the number of marginal wells declined steadily for nearly two decades under weak oil prices from more than 453,000 in 1992 to an estimated 375,600 in 2008. The sharp rise in oil prices in 2008 quickly reversed the decline by boosting the profitability of marginal oil wells. Since the low reached in 2008, sharply increased oil drilling activity has contributed to a 10 percent increase in the number of marginal oil wells. More than 34,000 marginal oil wells were added since 2008, pushing the total to 409,593 wells in the 2012 survey.

FIGURE 5. NUMBER OF MARGINAL OIL AND NATURAL GAS WELLS



Source: IOGCC Marginal Well Survey, U.S. EIA, and RegionTrack

Marginal production

Despite rising numbers of marginal wells, production from both marginal oil and natural gas wells remained relatively flat since the last survey in 2009 (see Figure 6).

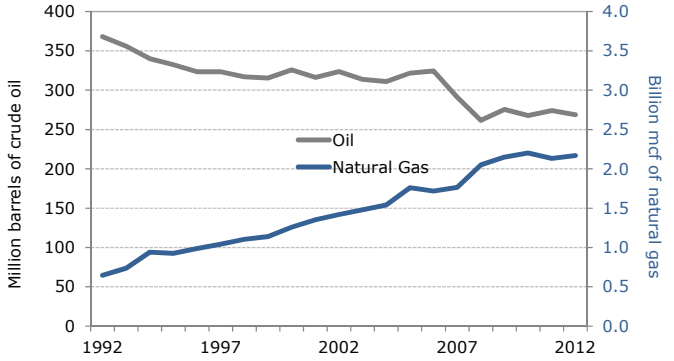
This stabilization is positive for marginal oil production given its steady downtrend much of the past two decades. Marginal oil production declined by nearly 30 percent in the period, from 368.1 million barrels in 1992 to only 261.6 million barrels by 2008. Production has since stabilized under elevated oil prices and eased off by only 2.4 percent since the 2009 survey to 268.7 million barrels in 2012.

Conversely, marginal natural gas production increased steadily much of the past two decades before stabilizing under sharply falling natural gas prices in 2009. Marginal natural gas production more than doubled from just less than 1 billion Mcf in 1999 to an all-time high of 2.20 billion Mcf in 2010. In the 2012 survey, more than 361,600 marginal natural gas wells produced 2.17 billion Mcf, down only slightly from the recent peak in production in 2010.

Figure 7 illustrates the change between 1992 and 2012 in the estimated market value of marginal oil and natural gas production. [6] Fluctuations in the price of both oil and natural gas can create large year-to-year changes in the market value of both sources of marginal production (see Figure 8). In 2012, the estimated market value of the 268.7 million barrels of marginal oil produced totaled $25.0 billion based on a historically high average price of $93.22 per barrel. Although the amount of oil produced has remained relatively flat since the last survey in 2009, rising oil prices increased the market value of marginal oil production by more than 60 percent in the period.

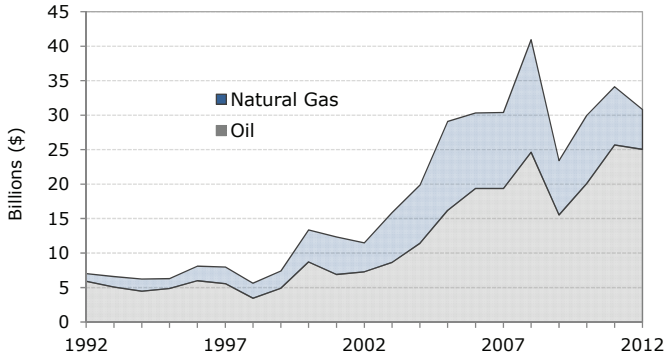
Relatively depressed natural gas prices in 2012 averaged only $2.67 per Mcf and reduced the market value of the 2.17 billion Mcf of marginal natural gas produced to only $5.79 billion. This

FIGURE 6. MARGINAL OIL AND NATURAL GAS PRODUCTION



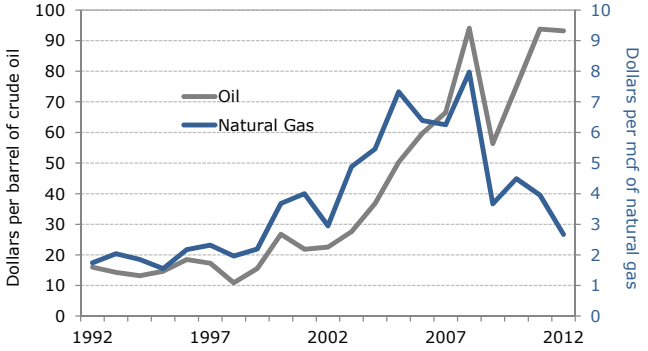
Source: IOGCC Marginal Well Survey, U.S. EIA, and RegionTrack

FIGURE 7. MARKET VALUE OF MARGINAL PRODUCTION



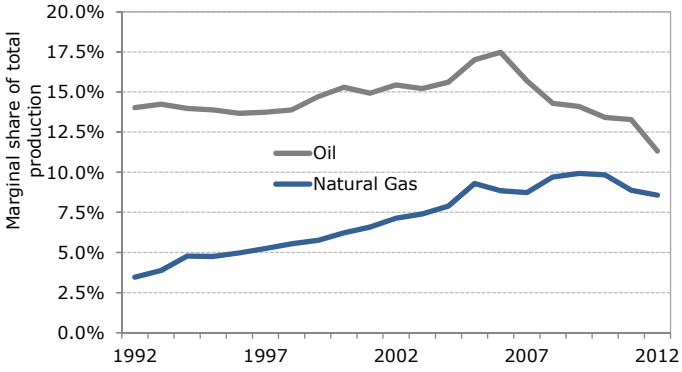
Source: IOGCC Marginal Well Survey, U.S. EIA, and RegionTrack

FIGURE 8. OIL AND NATURAL GAS PRICES



Source: IOGCC Marginal Well Survey, U.S. EIA, and RegionTrack

FIGURE 9. MARGINAL SHARE OF TOTAL U.S. PRODUCTION



Source: IOGCC Marginal Well Survey, U.S. EIA, and RegionTrack

is only about one-third the $16.3 billion in marginal natural gas produced in 2008 under peak natural gas prices and roughly one-fourth the current value of marginal oil production.

In total, the estimated market value of U.S. marginal oil and natural gas production reached $30.8 billion in 2012, or 10.7 percent of the value of all oil and natural gas produced domestically. This is down 25 percent from the peak value of $40.9 billion reached in 2008 when energy markets were driven by historically high prices for both oil and natural gas (see Figure 8). Conversely, it is more than 30 percent above the recent low of $23.4 billion in total marginal production set in 2008 as prices for both oil and natural gas moderated during the recent national recession.

Marginal production remains a substantial share of U.S. oil and gas output

The ongoing boom in U.S. oil and natural gas output has slowly lowered the share of total U.S. production derived from marginal wells. Despite the reduction in share, marginal wells remain a critical contributor to total U.S. production.

Figure 9 illustrates the share of total U.S. oil and natural gas produced from marginal wells the past two decades. While the number of barrels of oil produced from marginal wells has remained relatively flat since 2008, the share of total U.S. oil production from marginal wells has fallen steadily from a peak of 17.5 percent in 2006 (see Figure 9), the point at which unconventional drilling began to boost total production levels. The 268.7 million barrels of marginal oil produced in 2012 represent 11.3 percent of total domestic production of 2.37 billion barrels. For perspective, the volume of marginal oil produced in 2012 exceeded the total oil production of North Dakota (243.2 million barrels), California (197.2 million barrels), and Alaska (192.4 million barrels), the second-, third-, and fourth-largest oil-producing states after Texas.

The marginal share of total U.S. natural gas production increased steadily much of the past two decades before peaking at an all-time high of 9.9 percent in 2009 (see Figure 9). The marginal share of U.S. natural gas production has since retreated only slightly to 8.6 percent in 2012 as marginal gas production stabilized. The current volume of 2.17 billion Mcf of marginal natural gas is roughly equivalent to the total natural gas output of top-tier natural gas producing states such as Colorado, Oklahoma, Pennsylvania, and Wyoming.

Marginal well characteristics

Tables 1 and 2 contain a summary of the production characteristics of marginal oil and natural gas wells in 2012. A typical marginal oil well produced about 660 barrels of oil annually, or 1.80 barrels per day. The average output per well is down steadily from a recent high of 2.20 barrels per day in 2005.

The market value of oil produced per marginal oil well in 2012 was approximately $61,100 annually at an average oil price of $91.93 per barrel. The value of production from a typical marginal oil well has more than tripled the past decade under rising oil prices.

The average marginal natural gas well in the survey produced 16.4 Mcf of natural gas per day, or 6,000 Mcf annually, in 2012. The average output is down from an all-time high of 20.5 Mcf per day as recently as 2009 under severely depressed natural gas prices as many small wells were removed from production. The value of production from an average marginal natural gas well was only $16,012 in 2012 at an average price of $2.66 per Mcf of natural gas. This value is only about one-third the $50,659 in gas value produced at the recent natural gas price peak in 2008.

TRENDS IN MARGINAL PRODUCTION

across the states

Marginal oil and natural gas production has a long history in more than half the U.S. states. The traditional oil- and gas-producing states generally have both the longest production histories and the largest number of producing marginal wells. Tables 3 and 4 provide detailed state-level data from the current survey of marginal oil and natural gas production for calendar year 2012.

Marginal Oil Production

Marginal oil is produced from wells that operate on the lower edge of profitability. Generally speaking, low-volume "stripper" wells – defined by the IOGCC as those wells producing 10 barrels of oil per day or less – fall into this category.

The top marginal oil states in 2012 include the traditional oil-producing states of California, Kansas, Louisiana, New Mexico, Oklahoma, and Texas. Each of these six states produced more than 10 million barrels of oil from marginal wells. Jointly they accounted for 215.0 million barrels of marginal oil, or more than 75 percent of total U.S. marginal oil production in 2012. Texas and California alone produced more than 55 percent of total United States marginal oil output in 2012.

A second tier of seven states – Arkansas, Colorado, Illinois, Michigan, Ohio, Utah, and Wyoming - produced between 3 million and 10 million barrels of marginal oil each in 2012 and accounted for a total of 37.1 million barrels as a group. The thirteen states in the top two tiers accounted for nearly 95 percent of all marginal oil production. Overall, 20 of the 29 survey states produced more than 1 million barrels of oil from marginal wells in 2012.

Most survey states experienced an increase in the number of marginally-producing oil wells between the last survey in 2009 and 2012, the last year of data in the current survey. Of the net 15,400 marginal oil wells added in the period, states with the largest gains include Texas (+8,124 wells), Pennsylvania (+3,123 wells), California (+2,698 wells), Kansas (+2,504 wells), Colorado (+1,865 wells), and Kentucky (+1,165 wells). Most of the remaining states added 500 or fewer marginal wells in the period. Only five states reported a declining number of marginal oil wells in the period, including Louisiana (-3,290 wells), Ohio (-1,136 wells), Oklahoma (-2,507 wells), Indiana (-1,127 wells), and Arkansas (-160 wells). Texas and California now account for nearly 45 percent of all producing marginal oil wells, with 142,726 wells and 34,682 wells, respectively. Other states with more than 20,000 producing marginal oil wells include Illinois, Kansas, Kentucky, Ohio, Oklahoma, and Pennsylvania.

Although the total amount of marginal oil produced in the U.S. declined slightly between 2009 and 2012, marginal production increased in most reporting states. Four states that produce significant amounts of marginal oil – Louisiana, Ohio, Oklahoma, and Pennsylvania – accounted for most of the loss as each experienced a decline in marginal oil output between 2009 and 2012. These four states all produce more

than 2 million barrels of oil annually from marginal wells and experienced losses of between 12 percent and 48 percent in the period. All other states that experienced a decline in output were very small marginal oil producers and suffered relatively small percentage declines.

The average daily production rate for marginal oil wells has remained at or slightly below 2 barrels per day for many years but continues to vary widely across the states. Average daily production is highest in Nevada (4.43 Bbls), South Dakota (4.41 Bbls), North Dakota (4.11 Bbls), and Utah (4.07 Bbls), states where it exceeds 4 barrels per day. This rate is more than twice the overall average rate of daily production across all marginally producing states. States with especially low volume marginal wells (less than 1 barrel per day) include Kentucky (0.28 Bbls), New York (0.28 Bbls), Ohio (0.38 Bbls), Pennsylvania (0.25 Bbls), Virginia (0.15 Bbls), West Virginia (0.52 Bbls), and Illinois (0.98 Bbls).

The contribution of marginal oil to total state oil production also remains highly variable across the survey states. A number of states, including Illinois, Missouri, and New York, produce most or all (more than 90 percent) of their oil exclusively from marginal wells. A second group of states including Indiana, Kentucky, Nebraska, Ohio, and Pennsylvania produce between 50 percent and 90 percent of total state oil output from marginal wells. However, the majority of the major marginal oil-producing states generate one-third or less of total state oil output from marginal wells. Five of the six largest marginal oil-producing states - California, Louisiana, New Mexico, Oklahoma, and Texas - derive between 14 percent and 22 percent of total state oil production from marginal wells. The average across all marginal oil-producing states fell to 17.2 percent in 2012, down steadily from 25.0 percent in 2009.

Marginal Natural Gas Production

Marginal natural gas wells are defined by the IOGCC as those wells producing 60 Mcf of natural gas per day or less.

Eight states – Colorado, Kansas, Kentucky, New Mexico, Oklahoma, Pennsylvania, Texas, and West Virginia – are the leaders in marginal natural gas production. Each produced more than 100 million Mcf of natural gas from marginal wells in 2012. Jointly they accounted for 1.742 billion Mcf in 2012, or 80 percent of total U.S. marginal production. Texas and Oklahoma are the largest among the leaders and combined to produce 37 percent of total marginal natural gas output in 2012.

A second tier of six states including Alabama, Louisiana, Michigan, Montana, Ohio, and Wyoming produced between 50 million and 100 million Mcf of marginal natural gas each in 2012 and jointly accounted for a total of 253 million Mcf. The top two tiers of fourteen states produced more than 95 percent of all marginal natural gas output. Overall, 18 of the 28 states reporting marginal gas production in the survey produced more than 10 million Mcf of natural gas from marginal wells in 2012.

Consistent with the rebound in the number of marginal natural gas wells at the national level, 22 of the 28 states reporting marginal natural gas production posted an increase in wells between 2009 and 2012. Of the nearly 35,000 new marginal natural gas wells reported, states with the largest gains include Pennsylvania (+11,378 wells), Texas (+5,613 wells), West Virginia (+4,658 wells), Louisiana (+4,587 wells), Colorado (+3,566 wells), and Oklahoma (+2,458 wells). Most of the remaining states added 500 or fewer marginal gas wells in the period, while only six states posted a decline. Of the states with a decline, only four reported a decline of more than 100 wells in the period - Ohio (-2,187 wells), Wyoming (-974 wells), Kentucky (-367 wells), and Indiana (-101 wells).

By total well count, Pennsylvania, Texas, and West Virginia are the largest, with each having more than 50,000 marginal natural gas wells. These three states jointly accounted for nearly 50 percent of all marginal natural gas wells in 2012. Other states with more than 15,000 marginal natural gas wells include Colorado, Kansas, Kentucky, Louisiana, Ohio, and Oklahoma.

Although the U.S. posted a small 1 percent rise in total marginal natural gas output between the survey years of 2009 and 2012, 13 of the 28 states in the survey reported a decline in the period. Twelve of the 13 declining states experienced a decline of ten percent or more between 2009 and 2012. There is also tremendous variability in the production trend among the top producing states. Among the eight states that produced more than 100 million Mcf of marginal natural gas, five of them - Colorado, Kansas, New Mexico, Oklahoma, and Texas - saw an increase in output averaging 7.7 percent. The remaining three top producing states – Kentucky, Pennsylvania, and West Virginia - suffered an average decline of 26.1 percent in the period. Other than a steep decline reported in Louisiana, all other states that experienced a production decline were very small marginal gas producers and suffered only small percentage declines.

The daily production rate for all marginal natural gas wells has averaged 16.0 Mcf the past two decades and reached 16.4 Mcf in 2012. Daily production rates vary greatly across the producing states, with above average rates in Indiana (51.87 Mcf), Oklahoma (32.83 Mcf), Alabama (30.67 Mcf), and Utah (28.79 Mcf). States with low-volume marginal gas wells (less than 10 mcf per day) include Illinois (0.69 Mcf), Mississippi (2.03 Mcf), New York (4.43 Mcf), Ohio (5.24 Mcf), Pennsylvania (6.79 Mcf), and West Virginia (8.83 Mcf).

Similar to oil, the role of marginal natural gas production in total state natural gas output remains highly variable across the survey states. States that produce substantially all (90 percent or more) of their natural gas from marginal wells include Indiana, Maryland, Missouri, and Nebraska. A second group of states including Kansas, Kentucky, Michigan, Montana, and Ohio produce between 50 percent and 90 percent of total state natural gas output from marginal wells. In contrast, the eight largest natural gas-producing states measured by total volume averaged only 8.0 percent of total state natural gas output from marginal wells in 2012. This is just slightly below the overall average of 8.9 percent across all survey states.

ECONOMIC SPILLOVER EFFECTS
from marginal production

The $30.8 billion in marginal oil and natural gas produced in the U.S. in 2012 exerted tremendous economic impact across the energy-producing regions. Energy production triggers significant direct purchases of goods and services from other sectors which, in turn, induces spillover economic activity in other areas of the economy.

In order to assess the economic contribution of marginal production to the broader economy, this section examines the hypothetical case of the elimination of all marginal oil and natural gas production in the survey states. Estimates of the employment and income required to produce the lost output are formed and then used to estimate the spillover effects to the broader economy. Estimates are produced at the state level and then aggregated to assess the total expected effect on the broader U.S. economy.

Spillover effects

Keeping marginal wells in active production extends the life of a large and long-lived stream of direct economic impacts within a producing state. An operating marginal well provides a multi-year stream of revenue for firms and operators, payments to royalty owners, and tax revenue to state and local governments.

Marginal production also produces indirect, or spillover, economic impacts as producers purchase goods and services from firms in other sectors of the economy. Marginal wells must be monitored, maintained, and serviced on a continual basis by local servicing firms. The daily production of marginal oil and natural gas requires ongoing expenditures for electricity and other fuels, truck transportation, and storage. Well work-overs and stimulation are frequently used to extend the life of existing wells. Manufactured goods produced within the state support a well's operation until final shut-in. Marginal well activity also feeds downstream relationships with pipelines and refineries. And like all oil and gas activity, marginal production requires the ongoing use of significant legal, financial, and other business services. In short, nearly every major industry sector in every producing state benefits from some level of direct or indirect purchases from the sector.

In order to gauge the total economic contribution of marginal oil and natural gas production, a hypothetical simulation is evaluated where all marginal production is eliminated. The economic impacts are first estimated at the individual state level in order to capture differing degrees of economic linkages between the oil and natural gas sector and other industry sectors within each survey state. Many of the traditional energy-producing states such as California, Colorado, Kansas, Louisiana, Oklahoma, Texas, and Wyoming have a large and highly diverse industry mix that has developed over time to support oil and natural gas activity. The smaller producing states generally have smaller support sectors located within the state and must import significant quantities of both goods and services from outside the state to support oil and natural gas activity. The larger and more developed these linkages to other industries within a given state, the greater the economic spillover effects to other industries tend to be.

Impact analysis – RIMS II multipliers

Estimates of the economic spillover effects from marginal oil and gas production are formed using RIMS II input-output multipliers from the U.S. Bureau of Economic Analysis (BEA).[7] RIMS II multipliers provide model-based estimates of the impact that a local demand shock has on total gross output, value added, earnings, and employment within a region.[8] The demand shock in this case is the elimination of marginal production. The use of RIMS II multipliers maintains consistency with the approach used in marginal well reports in prior years.

Impact estimates are formed using Type-2 state-level multipliers derived for NAICS industry sector 211000, Oil and Gas Extraction.[9] While the RIMS II multipliers provide an assessment of the impacts to output, earnings, and employment, they do not account for other economic impacts such as tax payments to Federal, state, or local governments.[10] And while the estimated spillover effects are calculated for each state and then aggregated, they represent only an approximation of the total national impact.

Marginal oil impact

Table 5a provides an assessment of the economic contribution provided by marginal oil production in 2012. Again, the estimates are based upon a hypothetical elimination of all marginal oil production across the producing states. [11]

First, the value of lost oil output totaling $25.05 billion in 2012 is used to estimate both the employment required to produce the output and the earnings that would be lost. Using ratios of output to employment and output to earnings derived from RIMS multipliers for each state, the shuttering of marginal oil production would produce an estimated decline in direct

Table 5a. Economic Impact of Hypothetical Elimination of Marginal Oil Production

	Direct Impact			Multipliers			Total Impact		
Well Type	Lost Output ($)	Earnings Loss ($)	Employment Loss	Output	Earnings	Employ-ment	Lost Output ($)	Earnings Loss ($)	Employment Loss
Alabama	94,060,267	11,521,016	450	1.51	2.24	1.87	142,473,087	25,772,513	841
Arizona	1,759,679	205,107	4	1.47	2.27	2.82	2,591,479	465,963	10
Arkansas	279,213,598	37,025,685	1,446	1.52	2.08	1.75	423,287,815	77,146,717	2,537
California	4,423,188,284	686,907,728	10,443	1.69	2.31	2.87	7,481,822,983	1,587,924,594	29,933
Colorado	797,419,561	118,033,699	1,716	1.77	2.53	3.44	1,410,395,978	299,191,819	5,893
Illinois	869,297,040	122,250,017	4,773	1.66	2.39	1.78	1,445,988,696	291,823,016	8,507
Indiana	166,608,081	22,971,500	897	1.52	2.06	1.72	252,411,243	47,316,695	1,546
Kansas	1,458,002,525	217,649,363	8,499	1.50	1.88	1.59	2,192,252,597	409,115,509	13,472
Kentucky	235,430,347	35,821,198	1,399	1.55	1.98	1.69	364,705,151	71,076,422	2,364
Louisiana	1,043,944,698	142,075,843	2,646	1.65	2.34	2.75	1,717,602,212	331,974,414	7,287
Maryland	-	-	-	-	-	-	-	-	-
Michigan	281,821,000	44,057,237	1,720	1.58	2.13	1.77	444,628,992	93,987,304	3,050
Mississippi	117,902,169	15,017,700	452	1.51	2.10	2.02	177,737,520	31,468,089	911
Missouri	16,351,960	1,586,805	28	1.52	2.49	3.06	24,817,370	3,957,174	87
Montana	219,937,828	29,998,666	1,171	1.46	1.96	1.73	321,835,023	58,767,388	2,026
Nebraska	131,323,016	17,547,759	314	1.35	1.77	2.11	177,456,791	31,110,422	661
Nevada	5,503,900	824,227	15	1.44	1.95	2.35	7,950,383	1,603,286	35
New Mexico	1,392,018,966	206,618,472	3,736	1.51	1.98	2.45	2,107,934,320	408,835,970	9,167
New York	32,872,166	3,449,727	127	1.44	2.16	1.66	47,266,887	7,445,546	212
North Dakota	208,638,433	31,616,021	887	1.48	1.83	1.78	309,535,979	57,980,621	1,578
Ohio	360,875,639	53,054,566	2,072	1.65	2.28	1.82	593,856,952	120,821,164	3,771
Oklahoma	1,448,829,636	221,932,448	4,493	1.66	2.21	2.58	2,401,435,122	489,849,300	11,600
Pennsylvania	181,688,916	27,340,651	660	1.73	2.39	2.35	314,412,668	65,426,178	1,550
South Dakota	3,746,979	131,890	2	1.21	2.79	3.58	4,531,596	368,328	8
Texas	10,562,584,990	1,604,391,082	23,319	1.84	2.56	3.46	19,406,637,402	4,108,845,561	80,749
Utah	288,479,593	41,193,503	821	1.75	2.54	3.05	503,685,369	104,516,156	2,509
Virginia	15,029	2,106	0.1	1.53	2.10	1.67	22,964	4,423	0
West Virginia	72,256,773	11,293,979	441	1.55	1.93	1.67	112,221,994	21,814,320	735
Wyoming	353,797,354	52,395,859	843	1.46	1.84	2.30	516,544,137	96,162,121	1,938
Survey States	25,047,568,426	3,756,913,855	73,373	1.71	2.35	2.63	42,906,042,710	8,844,771,013	192,978

employment of 73,373 workers and lost direct earnings of $3.76 billion across the states reporting marginal oil production in 2012.

Approximately half of the direct economic loss is concentrated in the key oil producing states of Texas and California. The direct impact in these two states totals $15 billion in lost output, 33,761 lost jobs, and $2.29 billion in lost earnings. Four additional states – Kansas, Oklahoma, New Mexico, and Louisiana – all suffer direct reductions in state output of more than $1 billion. This represents a significant decline in the total output of all of the top six states but creates a proportionately greater loss in the four smaller states.

Next, RIMS II multipliers are used to estimate spillover economic changes in the broader economy of the survey states as a result of eliminating marginal oil production. In addition to the direct effects, the output multipliers in Figure 5a suggest that each dollar of reduced direct marginal oil output will reduce total output in the marginally producing states through spillover effects by an additional 71 cents (1.71-1.0). Each direct job lost as a result of eliminating marginal oil production will reduce total employment in these states by an additional 1.63 jobs (2.63-1.00). Similarly, reducing earnings from marginal oil production by one dollar reduces total earnings in the marginal producing states by an additional $1.35 (2.35-1.0).

Accounting for both direct and spillover effects, lost output from a hypothetical shuttering of marginal oil production would total an estimated $42.9 billion in 2012. This includes a loss of $25.05 billion in direct production and $17.9 billion in lost production in other areas of the economy through spillover effects. Total employment losses reach an estimated 192,978 FTE jobs, consisting of a direct loss of 73,373 jobs and an additional job loss of 119,605 through spillover effects. The total earnings decline is estimated at $8.84 billion, with just over $5 billion resulting from spillover wage losses in other sectors of the U.S. economy.

Including spillover losses, total economic output lost remains greatest in Texas (-$19.4 billion) and California (-$7.5 billion). Because of high employment multipliers in these two states, the share of total jobs lost in the scenario originating from these two states jumps from 46 percent to 57 percent. And as spillover effects are considered, two additional states – Illinois and Colorado - join a group of six states now expected to suffer a total output loss in excess of $1 billion from eliminating marginal oil production. These six states are expected to suffer total job losses ranging between 5,893 and 13,472 workers, as well as earnings declines ranging from $290 million to $490 million.

Marginal gas impact

Table 5b details the expected impact of eliminating marginal natural gas production based on an estimated lost value of natural gas output totaling $5.79 billion in 2012. Using RIMS multipliers for each state, the shuttering of marginal natural gas production produces an estimated direct decline in oil and gas employment of 22,069 workers, roughly one-third the estimated direct jobs lost under the scenario of ending marginal oil production. Direct earnings lost total an estimated $866.5 million in the 29 states reporting marginal production in 2012.

Nearly 40 percent of the direct loss in output is concentrated in the two key natural gas producing states of Texas and Oklahoma. Each of these states would suffer a direct loss in output of slightly more than $1 billion. Texas would see a slightly larger earnings loss of $178 million versus $160 million in Oklahoma, while Oklahoma faces a slightly larger employment loss of 3,243 jobs versus 2,584 jobs in Texas.

Six additional states – Kentucky, Pennsylvania, West Virginia, Kansas, New Mexico, and Colorado – would suffer direct reductions in output of between $334 million and $477 million if marginal gas production ceased. Four

Table 5b. Economic Impact of Hypothetical Elimination of Marginal Natural Gas Production

Well Type	Direct Impact			Multipliers			Total Impact		
	Lost Output ($)	Earnings Loss ($)	Employment Loss	Output	Earnings	Employ-ment	Lost Output ($)	Earnings Loss ($)	Employment Loss
Alabama	135,840,307	16,638,464	650	1.51	2.24	1.87	205,757,313	37,220,244	1,214
Arizona	42,735	4,981	0.1	1.47	2.27	2.82	62,935	11,316	0.3
Arkansas	60,299,853	7,996,184	312	1.52	2.08	1.75	91,414,577	16,660,849	548
California	19,895,060	3,089,643	47	1.69	2.31	2.87	33,652,495	7,142,327	135
Colorado	334,963,592	49,581,166	721	1.77	2.53	3.44	592,450,105	125,678,340	2,476
Illinois	705,094	99,158	4	1.66	2.39	1.78	1,172,853	236,700	7
Indiana	19,451,945	2,681,985	105	1.52	2.06	1.72	29,469,697	5,524,353	181
Kansas	443,041,031	66,136,784	2,583	1.50	1.88	1.59	666,156,495	124,317,313	4,094
Kentucky	476,189,290	72,453,153	2,830	1.55	1.98	1.69	737,664,829	143,761,547	4,782
Louisiana	150,213,517	20,443,336	381	1.65	2.34	2.75	247,146,299	47,767,898	1,049
Maryland	82,955	12,115	0.5	1.49	1.99	1.58	123,652	24,073	1
Michigan	180,475,603	28,213,853	1,102	1.58	2.13	1.77	284,736,358	60,188,613	1,953
Mississippi	2,868,495	365,372	11	1.51	2.10	2.02	4,324,256	765,601	22
Missouri	93,100	9,034	0.2	1.52	2.49	3.06	141,298	22,530	0.5
Montana	84,745,505	11,558,958	451	1.46	1.96	1.73	124,008,097	22,643,999	781
Nebraska	2,885,061	385,510	7	1.35	1.77	2.11	3,898,583	683,471	15
Nevada	-	-	-	-	-	-	-	-	-
New Mexico	370,757,008	55,031,755	995	1.51	1.98	2.45	561,437,338	108,891,333	2,442
New York	31,081,475	3,261,805	120	1.44	2.16	1.66	44,692,053	7,039,954	200
North Dakota	2,037,296	308,722	9	1.48	1.83	1.78	3,022,532	566,164	15
Ohio	170,280,494	25,033,992	978	1.65	2.28	1.82	280,213,581	57,009,909	1,779
Oklahoma	1,045,498,420	160,149,971	3,243	1.66	2.21	2.58	1,732,913,632	353,483,016	8,371
Pennsylvania	445,174,592	66,990,126	1,617	1.73	2.39	2.35	770,374,631	160,307,370	3,799
South Dakota	962,917	33,894	1	1.21	2.79	3.58	1,164,552	94,655	2
Texas	1,170,675,241	177,818,301	2,584	1.84	2.56	3.46	2,150,881,621	455,392,669	8,950
Utah	63,939,185	9,130,209	182	1.75	2.54	3.05	111,637,817	23,165,167	556
Virginia	36,137,369	5,063,671	198	1.53	2.10	1.67	55,217,900	10,635,228	330
West Virginia	443,145,280	69,265,110	2,705	1.55	1.93	1.67	688,248,935	133,785,560	4,511
Wyoming	99,262,863	14,700,401	237	1.46	1.84	2.30	144,923,779	26,979,646	544
Survey States	5,790,745,282	866,457,654	22,069	1.65	2.23	2.21	9,566,908,212	1,929,999,847	48,754

more states – Michigan, Ohio, Louisiana, and Alabama – would suffer estimated direct reductions in output of between $135 million and $180 million.

RIMS II multipliers are used next to estimate the spillover economic loss in the broader economy of the survey states as a result of eliminating marginal natural gas production. Using weighted average results for the states, the output multipliers in Table 5b suggest that each dollar of reduced direct output will reduce total economic activity in the broader U.S. economy through spillover effects by an additional 65 cents (1.65-1.0). Each direct job lost as a result of eliminating marginal natural gas production will reduce total U.S. employment by an additional 1.23 jobs (2.23-1.00). Similarly, reducing earnings from marginal oil production by one dollar will reduce total earnings in the U.S. economy by an additional $1.21 (2.21-1.0).

Overall, lost output from a hypothetical shuttering of marginal natural gas production totals an estimated $9.6 billion in 2012. This includes a loss of $5.8 billion in direct output and $3.8 billion in lost output in other areas of the economy through spillover effects. Total employment losses reach an estimated 48,754 FTE jobs, consisting of a direct loss of 22,069 jobs and an additional job loss of 26,685 through spillover effects. Total earnings decline by an estimated $1.93 billion, with a little over $1 billion resulting from spillover wage losses in other sectors of the U.S. economy.

Total lost output remains greatest in Texas (-$2.15 billion) and Oklahoma (-$1.7 billion), the two largest marginal natural gas-producing states. Because of relatively high employment multipliers in these two states, the share of total jobs lost originating from these states jumps from 26 percent of the total to 35 percent. Measured by total lost output, ten additional states are now expected to suffer a loss of between $205 million and $737 million once spillover effects are considered. These same ten states are expected to suffer total employment losses averaging 2,810 jobs and earnings declines averaging $100 million as marginal natural gas production ends.

Total impact of eliminating marginal oil and natural gas production

In total, the elimination of $30.8 billion in marginal oil and natural gas production in 2012 would trigger an estimated direct loss of 95,442 jobs and $4.62 billion in earnings within the industry. Including spillover effects, total output across the survey states would fall by $52.4 billion, 241,733 jobs would be lost, and earnings would decline by $10.8 billion.

Overall, Texas, California, and Oklahoma suffer the greatest loss in total output from eliminating marginal oil and natural gas production. These three states suffer estimated declines in output of $21.6 billion, $7.5 billion, and $4.1 billion, respectively. Total earnings (and total employment) lost in the three states reach $4.6 billion (89,698 jobs) in Texas, $1.6 billion (30,068 jobs) in California, and $843 million (19,971 jobs) in Oklahoma.

Seven additional states - Kansas, New Mexico, Louisiana, Colorado, Illinois, Kentucky, and Pennsylvania - all suffer estimated losses in total economic output ranging from $1.1 billion to $2.9 billion after accounting for spillover effects. Total earnings lost in these states from shuttering marginal oil and natural gas production ranges from $155 million to $533 million, while total employment losses range from 5,349 jobs to 17,566 jobs.

Twelve states suffer estimated output declines of between $100 million and $1 billion. These states include Alabama, Arkansas, Indiana, Michigan, Mississippi, Montana, Nebraska, North Dakota, Ohio, Utah, West Virginia, and Wyoming.

Two states - New York and Virginia - have estimated lost output of between $25 million and $100 million. Finally, the five smallest marginally-producing states - Arizona, Maryland, Missouri, Nevada, and South Dakota - experience less than $25 million in lost total output.

On average, each million dollars of lost marginal production across the survey states would reduce economic output by an additional $700,000. As a result, total employment would fall by 4.6 jobs and earnings would decline by $205,340 per million dollars of lost marginal production, including both direct and multiplier effects. The multiplier effects tend to be the highest in many of the traditional key energy producing states including Texas, Oklahoma, Colorado, Pennsylvania, Utah, Louisiana, and California.

Economically marginal wells present an added outlet for lost economic activity as they are plugged and abandoned. Once a marginal well is removed from production, a stream of economic benefits is forfeited going forward, potentially for many years into the future. While the decision to plug and abandon any individual well may seemingly have only a minor economic impact, when viewed cumulatively across the U.S. they have a large and significant impact on national and state-level oil and gas production. Concern over the potential impact of this lost economic activity is heightened once again as the number of plugged and abandoned wells resumed growth in recent years following many years of decline.

ECONOMIC LOSSES
from plugged and abandoned wells

Reversal in the number of plugged and abandoned wells

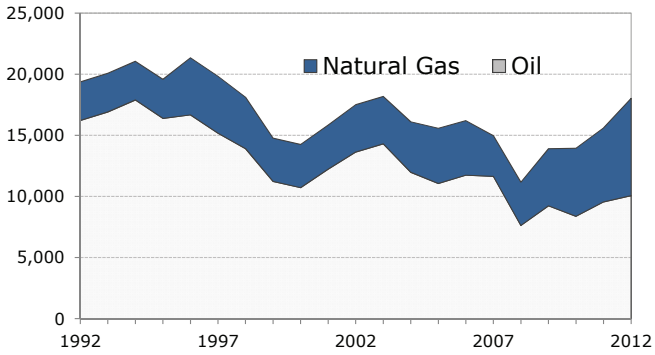
Tables 6a and 6b provide estimates of the number of oil and natural gas wells plugged and abandoned annually in the U.S. since 1992, including estimates of the amount and value of foregone production. Results from the current marginal well survey indicate acceleration in the number of plugged and abandoned wells since 2009. This reverses a steady long-run trend that had been intact for nearly two decades.

The rise in plugged and abandoned wells is present for both marginal oil and marginal natural gas wells. The numbers of plugged and abandoned oil wells declined steadily from 16,211 wells in 1992 and to only 7,624 wells in 2008 (see Figure 10). Following the surge in oil prices in 2008, the number rebounded quickly to more than 10,000 wells by 2012. Although marginal oil wells are much more profitable in the current elevated oil price environment, they must also compete against the increased number of drilling and exploration opportunities now available to producers across the county. On net, marginal wells are increasingly being plugged and abandoned despite high oil prices.

For natural gas, the number of wells plugged and abandoned the past two decades fluctuated in a narrow range between 3,000 and 4,500 wells annually and was driven largely by the level of natural gas prices. Under high natural gas prices in 2007 and 2008 that averaged nearly $7 per Mcf, the number of natural gas wells plugged and abandoned fell to only 3,400 annually.

However, persistently low natural gas prices since 2008 placed added priority on production from the most profitable gas wells and pushed the number up sharply. The number of plugged and abandoned marginal natural gas wells more than doubled to 7,959 between 2009 and 2012, a period in which natural gas prices averaged only $3.70 per Mcf.

FIGURE 10. PLUGGED AND ABANDONED WELLS



Source: IOGCC Marginal Well Survey, U.S. EIA, and RegionTrack

In total, more than 10,000 oil wells with annual production of 6.6 million barrels and nearly 8,000 natural gas wells producing 42.5 million Mcf of natural gas annually were plugged and abandoned in the U.S. in 2012. The estimated market value of the lost production from these wells totaled $751.3 million in 2012 - $624.3 million for oil and $127.0 million for natural gas. Over the past decade a cumulative total of more than 131,000 oil wells and 48,000 natural gas wells have been plugged and abandoned with a total market value of lost annual production estimated at $6.1 billion in the year production ceased.

Table 6a. National Plugged and Abandoned Oil Wells

Year	Number of Marginal Oil Wells	Production from Marginal Oil Wells (Bbls)	Value of Marginal Oil Production	Average Daily Production per Well (Bbls)	Oil Wells Plugged/ Abandoned	Lost Oil Production (Bbls)	Price of Oil ($/Bbl)	Lost Value of Oil Production ($)
1992	453,277	368,132,000	5,886,430,680	2.2	16,211	13,165,874	15.99	210,522,325
1993	452,248	355,961,000	5,072,444,250	2.2	16,914	13,312,882	14.25	189,708,572
1994	442,500	339,930,000	4,483,676,700	2.1	17,896	13,747,768	13.19	181,333,058
1995	433,048	332,288,089	4,858,051,861	2.1	16,389	12,562,169	14.62	183,658,903
1996	428,842	323,468,274	5,971,224,338	2.1	16,674	12,537,181	18.46	231,436,354
1997	420,674	323,487,914	5,573,696,758	2.1	15,172	11,684,716	17.23	201,327,653
1998	406,380	316,870,286	3,444,380,009	2.1	13,912	10,866,663	10.87	118,120,629
1999	410,680	315,514,283	4,909,402,243	2.1	11,227	8,605,496	15.56	133,901,510
2000	411,629	325,947,181	8,709,308,676	2.2	10,718	8,450,071	26.72	225,785,902
2001	403,459	316,099,192	6,903,606,353	2.2	12,234	9,600,632	21.84	209,677,792
2002	402,072	323,776,606	7,288,211,401	2.2	13,635	10,998,673	22.51	247,580,124
2003	393,463	313,748,001	8,646,894,908	2.2	14,300	11,378,510	27.56	313,591,736
2004	397,362	310,922,122	11,432,606,426	2.1	11,977	9,355,235	36.77	343,991,980
2005	401,072	321,761,570	16,178,171,740	2.2	11,058	8,871,323	50.28	446,050,143
2006	422,381	324,496,483	19,369,195,070	2.1	11,738	9,017,782	59.69	538,271,399
2007	396,537	291,067,592	19,361,816,220	2.0	11,639	8,543,303	66.52	568,300,509
2008	375,589	261,627,954	24,603,492,794	1.9	7,624	5,310,729	94.04	499,420,987
2009	394,202	275,409,538	15,519,327,466	1.9	9,229	6,447,848	56.35	363,336,242
2010	397,175	267,771,730	20,082,341,296	1.8	8,374	5,645,678	75.00	421,788,576
2011	405,501	273,904,970	25,680,839,751	1.9	9,551	6,451,443	93.76	617,596,622
2012	409,593	268,706,448	25,047,568,426	1.8	10,068	6,604,932	93.22	624,298,194

Table 6b. National Plugged and Abandoned Gas Wells

Year	Number of Marginal Gas Wells	Production from Marginal Gas Wells (Mcf)	Value of Marginal Gas Production	Average Daily Production per Well (Mcf)	Gas Wells Plugged/ Abandoned	Lost Gas Production (Mcf)	Price of Gas ($/Mcf)	Value of Lost Gas Production ($)
1992	130,432	647,193,099	1,126,115,993	13.6	3,161	15,684,632	1.74	27,291,260
1993	142,100	736,683,566	1,502,834,475	14.2	3,162	16,392,589	2.04	33,440,882
1994	159,369	940,421,000	1,739,778,850	16.2	3,163	18,664,556	1.85	34,529,429
1995	159,669	925,563,034	1,434,622,703	15.9	3,189	18,507,362	1.55	28,686,410
1996	168,702	986,676,219	2,141,087,395	16.0	4,671	27,278,640	2.17	59,194,649
1997	189,756	1,042,153,002	2,417,794,965	15.0	4,661	25,518,975	2.32	59,204,022
1998	199,745	1,104,683,975	2,165,180,591	15.2	4,203	23,318,244	1.96	45,703,758
1999	207,766	1,138,979,506	2,494,365,118	15.3	3,546	19,802,637	2.19	43,367,775
2000	223,222	1,258,726,664	4,632,114,124	15.4	3,534	19,864,614	3.68	73,101,780
2001	234,507	1,353,516,378	5,414,065,512	15.8	3,600	20,761,200	4.00	83,044,800
2002	245,961	1,418,273,779	4,183,907,648	15.8	3,870	22,318,290	2.95	65,838,956
2003	260,563	1,478,105,524	7,213,154,957	15.5	3,883	21,968,073	4.88	107,204,194
2004	271,856	1,539,960,495	8,408,184,303	15.5	4,129	23,359,818	5.46	127,544,604
2005	288,898	1,760,063,552	12,901,265,836	16.7	4,517	27,519,080	7.33	201,714,854
2006	304,000	1,716,319,702	10,967,282,896	15.5	4,463	25,197,154	6.39	161,009,814
2007	322,160	1,763,592,746	11,022,454,663	15.0	3,331	18,234,813	6.25	113,967,583
2008	322,507	2,049,935,800	16,337,988,326	17.4	3,545	22,532,914	7.97	179,587,322
2009	287,229	2,148,624,539	7,885,452,058	20.5	4,674	34,963,987	3.67	128,317,833
2010	343,695	2,201,917,684	9,879,554,234	17.6	5,569	35,678,334	4.49	159,838,936
2011	350,546	2,132,620,811	8,433,783,735	16.7	6,057	36,849,011	3.95	145,553,593
2012	361,641	2,169,829,168	5,790,745,282	16.4	7,959	47,753,625	2.67	127,024,641

The economic impact of plugged and abandoned wells

The direct economic impact of the output lost from marginal wells plugged and abandoned in 2012 is estimated in Table 7. The impacts are based on the amount of earnings and employment that would have been required to produce an additional year's output at prevailing market prices for oil and natural gas.

Using weighted average ratios derived from RIMS II multipliers from Table 8, the $751.3 million in lost oil and gas output would have directly supported an estimated 2,832 jobs with annual earnings of $110.2 million.

Spillover economic impacts to other sectors of the economy are formed using the average effective multiplier across the marginally-producing states from the previous sections of the report. With estimated spillover effects included, lost output from plugged and abandoned wells in 2012 produced a total decline in U.S. output of $1.25 billion. This in turn reduced total employment by 7,172 jobs and total earnings by an estimated $256.9 million annually in the U.S.

While these impacts are measured as annual reductions in economic activity, the reduced output may have persisted for many years going forward had these wells not been plugged and abandoned.

Well Type	Lost Output ($)
Alabama	229,900,574
Arizona	1,802,414
Arkansas	339,513,451
California	4,443,083,344
Colorado	1,132,383,154
Illinois	870,002,134
Indiana	186,060,027
Kansas	1,901,043,556
Kentucky	711,619,638
Louisiana	1,194,158,215
Maryland	82,955
Michigan	462,296,603
Mississippi	120,770,664
Missouri	16,445,060
Montana	304,683,332
Nebraska	134,208,077
Nevada	5,503,900
New Mexico	1,762,775,974
New York	63,953,640
North Dakota	210,675,729
Ohio	531,156,133
Oklahoma	2,494,328,056
Pennsylvania	626,863,507
South Dakota	4,709,896
Texas	11,733,260,231
Utah	352,418,778
Virginia	36,152,398
West Virginia	515,402,053
Wyoming	453,060,217
Survey States	30,838,313,709

Table 7. Economic Impact of Plugged and Abandoned Wells in 2012

	Direct Impact			Multipliers			Total Impact		
Well Type	Lost Output ($)	Earnings Loss ($)	Employment Loss	Output	Earnings	Employ-ment	Lost Output ($)	Earnings Loss ($)	Employment Loss
Crude Oil	624,298,194	93,412,492	2,379	1.70	2.33	2.53	1,062,274,962	217,697,885	6,026
Natural Gas	127,024,641	19,006,443	484	1.70	2.33	2.53	216,138,853	44,294,531	1,226
Total	751,322,836	112,418,936	2,863	-	-	-	1,278,413,815	261,992,416	7,252

Table 8. Economic Impact of Hypothetical Elimination of Marginal Oil and Natural Gas Production

Direct Impact		Multipliers			Total Impact		
Earnings Loss ($)	Employment Loss	Output	Earnings	Employ-ment	Lost Output ($)	Earnings Loss ($)	Employment Loss
28,159,480	1,100	1.51	2.24	1.87	348,230,399	62,992,757	2,055
210,089	4	1.47	2.27	2.82	2,654,414	477,279	11
45,021,869	1,758	1.52	2.08	1.75	514,702,392	93,807,567	3,085
689,997,370	10,489	1.69	2.31	2.87	7,515,475,477	1,595,066,921	30,068
167,614,865	2,436	1.77	2.53	3.44	2,002,846,084	424,870,159	8,369
122,349,175	4,777	1.66	2.39	1.78	1,447,161,549	292,059,716	8,514
25,653,485	1,002	1.52	2.06	1.72	281,880,941	52,841,048	1,727
283,786,148	11,081	1.50	1.88	1.59	2,858,409,092	533,432,822	17,566
108,274,352	4,229	1.55	1.98	1.69	1,102,369,981	214,837,969	7,146
162,519,178	3,027	1.65	2.34	2.75	1,964,748,511	379,742,312	8,335
12,115	0.5	1.49	1.99	1.58	123,652	24,073	1
72,271,090	2,822	1.58	2.13	1.77	729,365,350	154,175,917	5,002
15,383,073	463	1.51	2.10	2.02	182,061,776	32,233,690	933
1,595,839	29	1.52	2.49	3.06	24,958,668	3,979,705	87
41,557,624	1,623	1.46	1.96	1.73	445,843,120	81,411,386	2,807
17,933,269	321	1.35	1.77	2.11	181,355,374	31,793,893	675
824,227	15	1.44	1.95	2.35	7,950,383	1,603,286	35
261,650,227	4,731	1.51	1.98	2.45	2,669,371,658	517,727,304	11,609
6,711,532	248	1.44	2.16	1.66	91,958,940	14,485,500	412
31,924,742	896	1.48	1.83	1.78	312,558,511	58,546,785	1,594
78,088,558	3,049	1.65	2.28	1.82	874,070,533	177,831,073	5,550
382,082,419	7,736	1.66	2.21	2.58	4,134,348,753	843,332,316	19,971
94,330,777	2,276	1.73	2.39	2.35	1,084,787,299	225,733,549	5,349
165,783	3	1.21	2.79	3.58	5,696,149	462,983	11
1,782,209,383	25,903	1.84	2.56	3.46	21,557,519,023	4,564,238,230	89,698
50,323,712	1,004	1.75	2.54	3.05	615,323,186	127,681,323	3,066
5,065,777	198	1.53	2.10	1.67	55,240,863	10,639,651	331
80,559,089	3,146	1.55	1.93	1.67	800,470,929	155,599,880	5,246
67,096,261	1,080	1.46	1.84	2.30	661,467,917	123,141,767	2,481
4,623,371,509	95,442	1.70	2.33	2.53	52,472,950,922	10,774,770,860	241,733

CONCLUSION

The resurgence in U.S. oil and natural gas production the past decade has not diminished the role of marginal wells in domestic energy production. Currently, an estimated 771,000 marginally-producing wells – nearly 410,000 oil wells and more than 361,000 natural gas wells - serve a strategic role within the U.S. energy production framework.

The 268.7 million barrels of marginal oil produced in the U.S. in 2012 now represent 11.3 percent of total domestic production of 2.37 billion barrels. For perspective, the volume of marginal oil produced in 2012 exceeds the total oil production of North Dakota (243.2 million barrels), California (197.2 million barrels), and Alaska (192.4 million barrels), the second-, third-, and fourth-largest oil-producing states after Texas.

Marginal natural gas production reached 2.17 billion Mcf in the U.S. in 2012. This represents 8.6 percent of the 25.3 billion Mcf of total natural gas produced domestically in 2012. Marginal natural gas output is roughly equal to the total natural gas output of top-tier natural gas producing states such as Colorado, Oklahoma, Pennsylvania, and Wyoming.

The estimated value of marginal oil and natural gas produced in 2012 reached $30.8 billion. The value of the 268.7 million barrels of marginal oil produced totaled $25.0 billion based on a historically high average price of $93.22 per barrel. Relatively depressed natural gas prices in 2012 averaged only $2.67 per Mcf and reduced the market value of the 2.17 billion Mcf of marginal natural gas produced to only $5.79 billion.

Marginal oil and natural gas production in the U.S. continues to exert tremendous economic impact across the energy-producing regions. The hypothetical elimination of $30.8 billion in marginal oil and natural gas production in 2012 would trigger an estimated direct loss of 95,442 jobs and $4.62 billion in earnings within the oil and natural gas industry. Including spillover effects to other industries, total output across the survey states would fall by $52.4 billion, 241,733 jobs would be lost, and earnings would decline by $10.8 billion.

Overall, Texas, California, and Oklahoma suffer the greatest loss in total output from eliminating marginal oil and natural gas production. These three states suffer estimated declines in output of $21.6 billion, $7.5 billion, and $4.1 billion, respectively. Total earnings (and total employment) lost in the three states reach $4.6 billion (89,698 jobs) in Texas, $1.6 billion (30,068 jobs) in California, and $843 million (19,971 jobs) in Oklahoma. Seven additional states - Kansas, New Mexico, Louisiana, Colorado, Illinois, Kentucky, and Pennsylvania - all suffer estimated losses in total economic output ranging from $1.1 billion to $2.9 billion after accounting for spillover effects. Twelve states - Alabama, Arkansas, Indiana, Michigan, Mississippi, Montana, Nebraska, North Dakota, Ohio, Utah, West Virginia, and Wyoming - suffer estimated output declines of between $100 million and $1 billion. Two states - New York and Virginia - have estimated lost output of between $25 million and $100 million. The five smallest marginally-producing states -

Arizona, Maryland, Missouri, Nevada, and South Dakota - experience less than $25 million in lost total output.

The large number of plugged and abandoned wells each year presents another potential economic cost to U.S. energy production. Over the past decade a cumulative total of more than 131,000 oil wells and 48,000 natural gas wells have been plugged and abandoned with a total market value of lost annual production estimated at $6.1 billion in the year production ceased. The estimated market value of the lost production from these wells totaled $751.3 million in 2012 - $624.3 million for oil and $127.0 million for natural gas. With estimated spillover effects included, lost output from plugged and abandoned wells would create a total decline in U.S. output of $1.25 billion. This in turn reduces total employment by 7,172 jobs and total earnings by an estimated $256.9 million annually in the U.S.

APPENDIX
Marginal Well Survey Data Notes

Marginal well production data for calendar years 2010, 2011, and 2012 were collected in a recent survey of state oil and gas reporting entities. Data reported for years prior to 2010 are from earlier IOGCC surveys and are detailed in prior Marginal Well annual reports.

Twenty-seven of the twenty-nine states in the report produce both marginal oil and marginal natural gas; Nevada reported only oil and Maryland only natural gas.

A few states not included in the survey results have very small amounts of marginal oil and gas production. These states include Alaska, Florida, Georgia, Nevada (gas), South Carolina, and Tennessee. Omitting the small amount of production from these states does not materially affect the results presented in this report.

Marginal oil production data:

Oil production data is as reported from the IOGCC annual marginal well survey for the following states: Alabama, Arizona, California, Indiana, Kansas, Louisiana, Michigan, Mississippi, Nebraska, New Mexico, New York, North Dakota, Ohio, South Dakota, Texas, Utah, Virginia, West Virginia, and Wyoming. For the remaining states:

Arkansas: Total oil production for 2010-2012 is from EIA.

Colorado: The state of Colorado reports stripper production only for oil wells producing 15 barrels or less of oil per day. To match IOGCC's definition of a marginal well, estimates of production for wells producing 10 barrels or less per day were formed for 2010-2012 using production ratios by well size from the 2009 Distribution and Production of Oil and Gas Wells by State series provided from EIA. The number of oil wells was adjusted in the same manner using the ratio of wells by well size from the same survey.

Illinois: Total oil production for 2010-2012 is from EIA. Consistent with past surveys, all oil production is assumed marginal. The number of marginal wells for 2010-2012 is estimated using the output per marginal well from 2009.

Kentucky: Total oil production for 2012 is from EIA.

Maryland: Marginal gas production was reported, but no marginal oil.

Missouri: Total oil production for 2012 is from EIA. Consistent with past surveys, all oil production is assumed marginal. The number of marginal wells for 2012 is estimated using the output per marginal well from 2012.

Montana: Total oil production for 2010-2012 is from EIA. Marginal oil production for 2010-2012 is estimated using a linear model based on total oil production, total oil production per well, and historical marginal production. The number of marginal wells for 2010-2012 is estimated using the output per marginal well from 2009.

Nevada: Total oil production for 2012 is from EIA.

Oklahoma: Total oil production for 2010-2012 is from EIA. Marginal oil production for 2010-2012 is estimated using a linear model based on total oil production, total oil production per well, and historical marginal production. The number of marginal wells for 2010-2012 is estimated using the output per marginal well from 2009.

Pennsylvania: Marginal and total oil production for 2012 is calculated from well-level production files provided by the Pennsylvania Department of Environmental Protection.

Marginal natural gas production data:

Natural gas production data is as reported from the IOGCC annual survey for the following states: Alabama, Arizona, California, Indiana, Kansas, Louisiana, Michigan, Mississippi, Nebraska, New Mexico, New York, North Dakota, Ohio, South Dakota, Texas, Utah, Virginia, West Virginia, and Wyoming. For the remaining states:

Arkansas: Total gas production for 2010-2012 is from EIA.

Colorado: The state of Colorado reports stripper production only for oil wells producing 90 Mcf or less of gas per day. To match IOGCC's definition of a marginal well, estimates of production for wells producing 60 Mcf or less per day were formed using production ratios by well size from the 2009 Distribution and Production of Oil and Gas Wells by State series provided from EIA. The number of natural gas wells was adjusted in the same manner using the ratio of wells by well size from the same survey.

Illinois: Total gas production for 2010-2012 is from EIA. Marginal gas production for 2010-2012 is estimated using the ratio of marginal production to total production from 2009. The number of marginal gas wells for 2010-2012 is estimated using the output per marginal well from 2009.

Kentucky: Total gas production for 2010-2012 is from the Kentucky Geological Survey.

Maryland: Consistent with past surveys, marginal gas production is assumed equal to total gas production for 2012. The number of marginal gas wells in 2012 is assumed unchanged from 2011.

Missouri: Total gas production for 2012 is from EIA. Consistent with past surveys, all oil production is assumed marginal. The number of marginal gas wells in 2012 is assumed unchanged from 2011.

Montana: Total gas production for 2010-2012 is from EIA. Marginal gas production for 2010-2012 is estimated using a linear model based on total gas production, total gas production per well, and historical marginal production. The number of marginal gas wells for 2010-2012 is estimated using the output per marginal well from 2009.

Nevada: Marginal oil production was reported, but no marginal gas production.

Oklahoma: Total gas production for 2010-2012 is from EIA. Marginal gas production for 2010-2012 is estimated using a linear model based on total gas production, total gas production per well, and historical marginal gas production. The number of marginal gas wells for 2010-2012 is estimated using the output per marginal well from 2009.

Pennsylvania: Marginal and total gas production for 2012 are estimated from well-level production files produced by the Pennsylvania Department of Environmental Protection.

U.S.: Total marginal natural gas production and the number of marginal natural gas wells are estimated in 1992 and 1993 using a simple linear regression based on a time trend and data reported in IOGCC surveys in the 1994 to 2012 period.

ENDNOTES

[1] See: U.S. Energy Information Administration. Oct. 4, 2013. *"U.S. expected to be largest producer of petroleum and natural gas hydrocarbons in 2013."* Available online at: http://www.eia.gov/todayinenergy/detail.cfm?id=13251

[2] The total for Mining includes investment spending for oil and natural gas wells as well as for coal and other minerals. Based on data from the 2007 Economic Census, less than 10 percent of the total is related to non-oil and gas activity.

[3] While the ranks of the energy states have changed over time, a core group of 13 states have been viewed as the energy states over much of the postwar period. These states include Alaska; the "oil patch" states of Louisiana, Mississippi, Oklahoma, and Texas; the Mountain states of Colorado, Montana, New Mexico, Utah, and Wyoming; the Central Plains states of Kansas and North Dakota; and West Virginia in the Appalachian region. For more discussion, see: Mark C. Snead. "Are the Energy States Still Energy States?" 2009. Economic Review. Federal Reserve Bank of Kansas City. Available online at:
http://www.kc.frb.org/PUBLICAT/ECONREV/pdf/09q4Snead.pdf

[4] EIA maintains a compilation of completed, approved, and proposed natural gas pipeline projects from multiple industry sources. The file is available online at:
http://www.eia.gov/naturalgas/pipelines/EIA-NaturalGasPipelineProjects.xls

[5] Recent Marginal Wells reports are available online at: http://iogcc.ok.gov

[6] The market value of marginal production is estimated at the state level using prices for oil and natural gas from the U. S. Energy Information Agency (EIA). Oil prices reflect the value of field production, while natural gas prices are reported for marketed production. The market value of total U.S. production is estimated using the U.S. crude oil first purchase price for oil and the wellhead price for natural gas.

[7] The multipliers are based on the 2010 updated input-output model underlying the RIMS II estimates.

[8] Caution must always be used when using input-output multipliers to assess the total economic activity 'supported' by an existing industry or firm. Input-output multipliers are intended to predict the change in economic activity that results from an incremental change in the current state of a regional economy. More specifically, the estimates we provide for marginal oil and natural gas production reflect predictions from the RIMS II input-output model of the incremental impact that would result if industry revenue in the marginally producing states contracted. The actual realized impact is determined by the unique adjustment process that would take place in each state as marginal production changed.

[9] The estimated spillover effects include both indirect and induced effects. The indirect effect is the statewide inter-industry economic activity resulting from purchases by the state's marginal producers, while the induced effect reflects the economic activity resulting from new household spending out of employee earnings received as part of the direct and indirect effects. For convenience, the spillover impacts are typically summarized using economic impact multipliers. The multipliers quantify the amount of spillover activity resulting from each dollar of activity in the state oil and natural gas sector. The indirect and induced effects are derived using Type II multipliers calculated as (direct + indirect + induced)/direct. More generally, RIMS II output multipliers provide an estimate of the amount of output generated statewide per dollar of new output generated in the oil and natural gas industry. Employment multipliers provide an estimate of the number of FTE jobs generated statewide per new job added in the oil and gas industry. Earnings multipliers provide an estimate of the amount of new labor income generated statewide per new dollar of labor income added in the oil and natural gas industry.

[10] Input-output models also do not account for subsequent general equilibrium-type effects such as changes in the relative prices of goods and services or changes in wage rates at the industry level.

[11] The impact estimates presented are gross estimates in the sense that they ignore any potential economic activity that might be absorbed by other industry sectors over time. The estimates are best viewed as providing an upper bound on the spillover effects. The ultimate net effect is an empirical modeling question that cannot be answered with certainty.

FREQUENTLY USED ABBREVIATIONS

Oil

bbls = barrels

Mbbls = one thousand barrels (1,000 barrels)

MMbls = one million barrels (1,000,000 barrels)

BOPD = barrels of oil per day

BOEPD = barrels of oil equivalent per day

MMBOE = million barrels of oil equivalent (1,000,000 barrels of oil equivalent)

Natural Gas

Mcf = one thousand cubic feet (1,000 cubic feet)

Bcf = one billion cubic feet (1,000,000,000 cubic feet)

MCFD = one thousand cubic feet per day (1,000 cubic feet per day)

MMCF = one million cubic feet (1,000,000 cubic feet)

MMCFD = one million cubic feet per day (1,000,000 cubic feet per day)

Source: Langenkamp, Robert D., ed. The Illustrated Petroleum Reference Dictionary. 4th ed. PennWell Books: Tulsa, 1994.

Thank you...

The IOGCC would like to recognize and thank Mark C. Snead for analyzing the data and composing the valuable assessment for this report. Mr. Snead is a regional economist and president of RegionTrack, Inc. (regiontrack.com), an Oklahoma City-based economic research firm specializing in regional economic forecasting and analysis.

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