marginal wells:

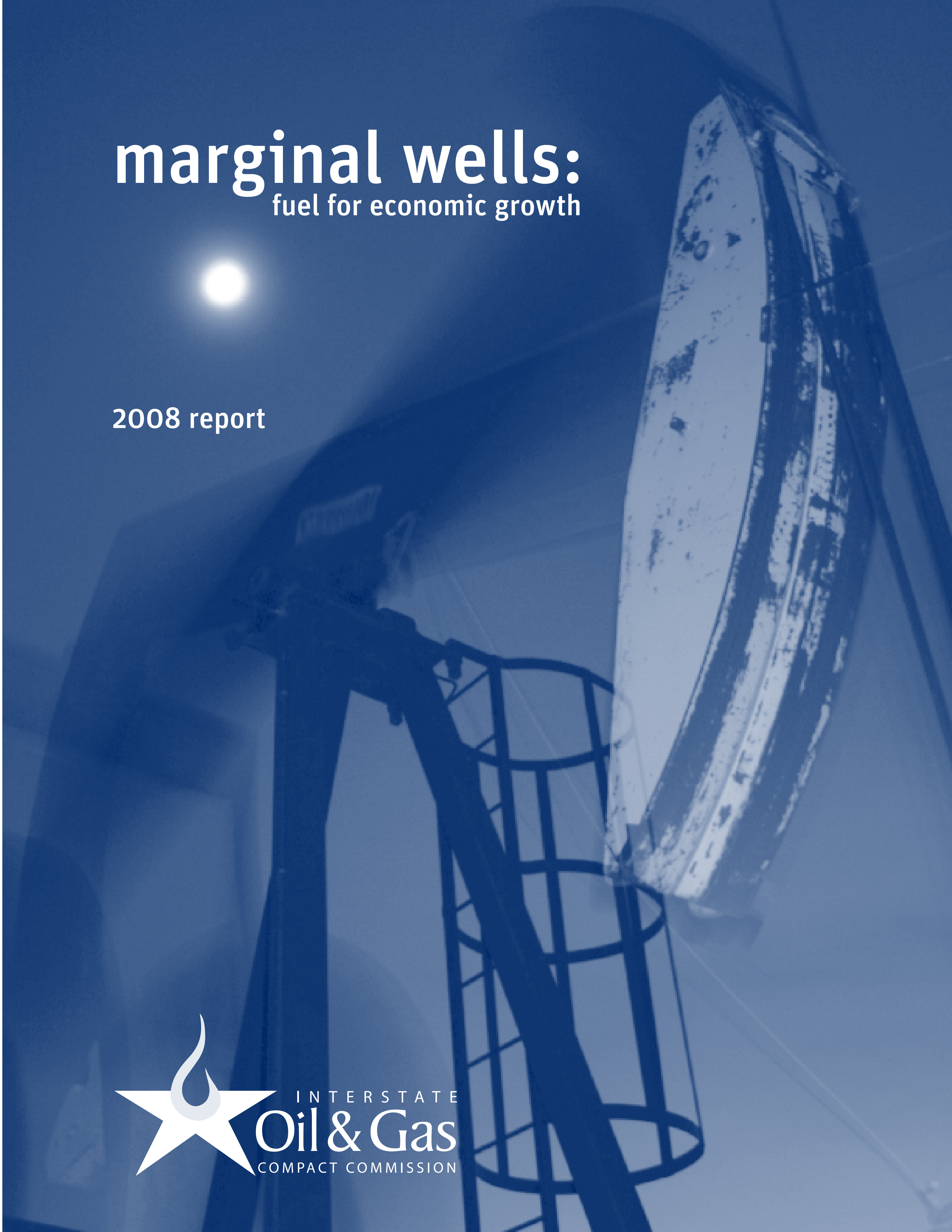
fuel for economic growth

2008 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 www.iogcc.state.ok.us or call 405-525-3556.



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INTERSTATE
Oil & Gas
COMPACT COMMISSION

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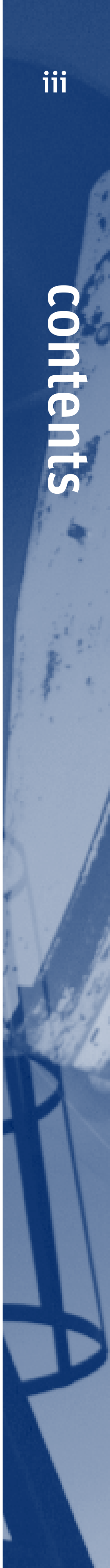
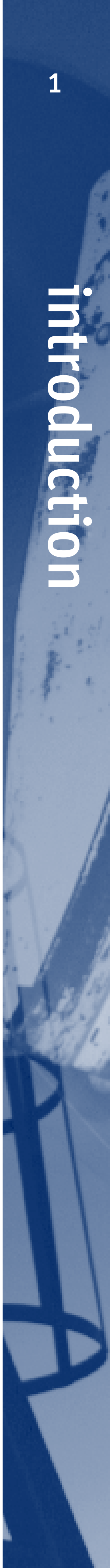


introduction



introduction

For more than 65 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 (stripper) well as a well the produces 10 barrels of oil or 60 thousand cubic feet (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 which 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. In fact, every $1 million directly generated by marginal production results in more than $2 million of activity elsewhere in the economy. Additionally, the tax dollars paid in 2007 by marginal producers to states amounted in nearly $1.3 billion that can be reinvested in states to help communities thrive.

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 aid in ensuring a sound energy and economic future.

marginal oil

marginal oil

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 IOGCC has monitored the status of marginal wells in the United States since the 1940s.

Why all the concern about such small-volume wells? While each individual well contributes only a small amount of oil (2.01 barrels per day, on average), there are 396,537 of these wells in the United States. Combined, these marginal wells produced more than 291 million barrels of oil in 2007.

plugged/abandoned wells

Many states have programs that allow a well to temporarily stop production. These "idle" wells are not included in the abandoned well category of this report; only wells that have been permanently plugged are included in the IOGCC's definition.

Also not included in this study's abandoned well figures are "orphaned" wells. These are wells that are not producing, have not been plugged, and whose owners are either insolvent or cannot be located.

enhanced oil recovery

U.S. oil production reached its peak in 1971 and has declined steadily since 1986. Enhanced oil recovery has been and will continue to be instrumental in recovering additional oil resources.

There are two enhanced oil recovery methods: secondary and tertiary. The team "secondary recovery: generally refers to waterflooding or hydrocarbon gas re-injection. Reservoir pressure is increased, or maintained, and oil is swept to the producing wells.

Secondary Recovery of Marginal Wells*
2007 calendar year

State	Estimated Secondary Oil Produced from Marginal Wells (Bbls)	Percent of Total Marginal Production
Alabama	925,286	91.7%
Arkansas	399,872	12.7%
Colorado	986,716	13.8%
Florida	2,940	73.7%
Indiana	1,137,267	90.0%
Kentucky	1,214,126	67.6%
Nebraska	971,670	59.4%
New Mexico	5,693,875	38.4%
New York	19,147	4.9%
North Dakota	716,544	30.2%
Ohio	48,735	1.1%
South Dakota	44,094	69.9%
Utah	1,244,840	54.8%
West Virginia	327,089	39.0%

* All states were surveyed. The table below only represents marginal oil well reserves from states that responded.

In older oil fields, reservoir pressure has diminished over time, decreasing the flow of oil. Secondary recovery operations permit the injection of a fluid, such as water or gas, into the formation. This increases the reservoir pressure and displaces more of the trapped oil in the reserve. In many states, the majority of marginal oil that was produced in 2007 was the result of secondary recovery methods.

"Tertiary recovery" follows waterflooding operations and generally involves the injection of a miscible fluid. Carbon dioxide is such a miscible fluid. Tertiary recovery can be achieved by using several methods. In on commonly used EOR technique, carbon dioxide is injected into a reservoir. As the CO_2 is injected it dissolves in the oil reducing the viscosity and surface tension of the oil droplets. The reduction in viscosity improves the flow rates of the remaining oil. Other techniques include thermal recovery, which uses heat to improve the flow of the oil, and chemical injection. The IOGCC does not track the amount of marginal oil produced using tertiary recovery at this time.

The National Petroleum Council in its 2007 Global Oil and Gas Study recommended the promotion of enhanced oil recovery by supporting regulatory streamlining and research and development programs for marginal wells and by expediting permitting of EOR projects, pipelines and associated infrastructure. The study indicates the potential effect of this could be an additional 90 to 200 billion barrels of recoverable oil in the United States alone, which could help slow the current decline in production.

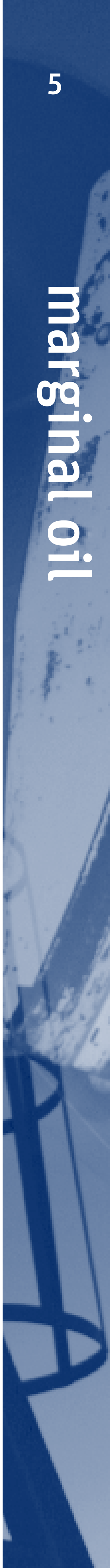
marginal oil well reserve

An oil resource is defined as a reserve when it is deemed economically recoverable. To date, there is no comprehensive determination of the total marginal oil reserve in the United States. The table below indicates estimates by a handful of IOGCC marginal oil well survey respondents.

Marginal Oil Well Reserve
2007 Calendar Year

	Marginal Oil Well Reserves (Bbls)*		
State	Primary	Secondary	Total
Arizona	430,000	0	430,000
Kentucky	9,200,000	13,500,000	22,700,000
Nebraska	1,863,079	2,729,209	4,592,288
New York	2,599,714	135,358	2,735,072
Ohio	34,186,810	113,190	34,300,000
Utah	2,791,560	4,803,910	7,595,470

* All states were surveyed. The table below only represents marginal oil well reserves from states that responded.



National Marginal Oil Well Survey*
2007 Calendar Year

State	Number of Marginal Oil Wells	Production from Marginal Oil Wells (Bbls)	Oil Wells Plugged and Abandoned	Average Daily Production Per Well	Total 2007 Oil Production (Bbls)
Alabama	693	1,009,557	3	3.99	5,082,417
Arizona	15	17,721	0	3.24	42,692
Arkansas	4,102	3,150,508	52	2.10	6,058,670
California	29,460	39,280,587	2,013	3.65	243,184,615
Colorado	6,866	7,170,856	51	2.86	23,111,389
Florida	2	3,987	2	5.46	2,077,773
Illinois	25,629	10,000,000	725	1.07	10,000,000
Indiana	5,130	1,263,630	365	0.67	1,726,553
Kansas	17,020	14,542,290	749	2.34	36,624,285
Kentucky	18,618	1,796,536	197	0.26	2,617,725
Louisiana	19,547	19,931,314	514	2.79	52,495,101
Michigan	2,205	3,044,541	61	3.78	5,859,011
Mississippi	1,302	1,192,175	43	2.51	20,394,840
Missouri	326	79,515	27	0.67	79,515
Montana	2,532	2,017,196	40	2.18	34,840,000
Nebraska	1,473	1,634,975	20	3.04	2,335,375
Nevada	33	59,203	6	4.92	425,705
New Mexico	14,975	14,832,271	331	2.71	53,288,582
New York	3,559	386,887	91	0.30	386,887
North Dakota	1,471	2,370,729	7	4.42	47,979,226
Ohio	29,120	4,522,244	212	0.43	5,454,629
Oklahoma	45,892	27,911,928	747	1.67	49,310,639
Pennsylvania	18,200	3,600,000	128	0.54	3,600,000
South Dakota	30	63,054	0	5.76	1,664,889
Tennessee	347	126,956	125	1.00	285,284
Texas	130,106	119,683,522	4,781	2.52	341,341,163
Utah	1,412	2,271,425	83	4.41	19,523,218
Virginia	3	1,698	0	1.55	19,155
West Virginia	3,897	838,947	28	0.59	1,467,473
Wyoming	12,572	8,263,340	238	1.80	53,985,716
TOTALS	**396,537**	**291,067,592**	**11,639**	**2.01**	**1,025,262,527****

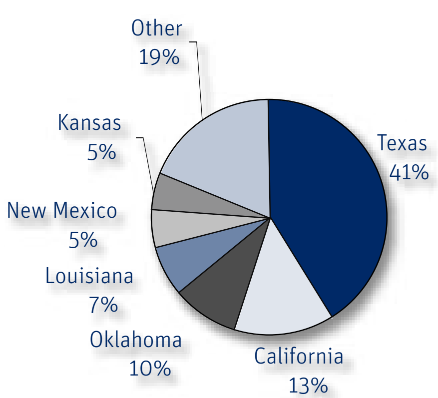
* Numbers are estimates by states, survey respondents are listed in acknowledgement section

** Total represents only oil production from states with marginal wells.

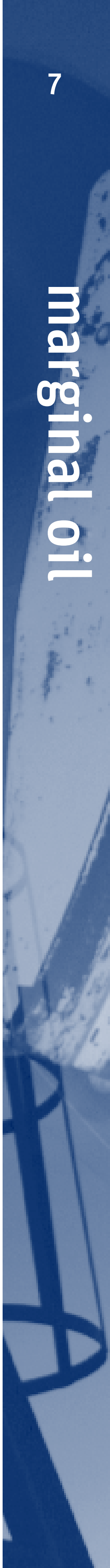
U.S. State Rankings

Number of Marginal Oil Wells	Production from Marginal Oil Wells (Bbls)	Oil Wells Plugged and Abandoned	Average Daily Production Per Well
Texas	Texas	Texas	South Dakota
Oklahoma	California	California	Florida
California	Oklahoma	Kansas	Nevada
Ohio	Louisiana	Oklahoma	North Dakota
Illinois	New Mexico	Illinois	Utah
Louisiana	Kansas	Louisiana	Alabama
Kentucky	Illinois	Indiana	Michigan
Pennsylvania	Wyoming	New Mexico	California
Kansas	Colorado	Wyoming	Arizona
New Mexico	Ohio	Ohio	Nebraska
Wyoming	Pennsylvania	Kentucky	Colorado
Colorado	Arkansas	Pennsylvania	Louisiana
Indiana	Michigan	Tennessee	New Mexico
Arkansas	North Dakota	New York	Texas
West Virginia	Utah	Utah	Mississippi
New York	Montana	Michigan	Kansas
Montana	Kentucky	Arkansas	Montana
Michigan	Nebraska	Colorado	Arkansas
Nebraska	Indiana	Mississippi	Wyoming
North Dakota	Mississippi	Montana	Oklahoma
Utah	Alabama	West Virginia	Virginia
Mississippi	West Virginia	Missouri	Illinois
Alabama	New York	Nebraska	Tennessee
Tennessee	Tennessee	North Dakota	Indiana
Missouri	Missouri	Nevada	Missouri
Nevada	South Dakota	Alabama	West Virginia
South Dakota	Nevada	Florida	Pennsylvania
Arizona	Arizona	Arizona	Ohio
Virginia	Florida	South Dakota	New York
Florida	Virginia	Virginia	Kentucky

Production from Marginal Oil Wells (Bbls)



State	Production from Marginal Oil Wells (Bbls)
Texas	119,683,522
California	39,280,587
Oklahoma	27,911,928
Louisiana	19,931,314
New Mexico	14,832,271
Kansas	14,542,290
Other	54,885,680



Comparative Number of Marginal Oil Wells and Marginal Oil Well Production 2004-2007

	2004		2005		2006		2007	
State	Number of Marginal Wells	Production from Marginal Wells (Bbls)	Number of Marginal Wells	Production from Marginal Wells (Bbls)	Number of Marginal Wells	Production from Marginal Wells (Bbls)	Number of Marginal Wells	Production from Marginal Wells (Bbls)
Alabama	669	1,141,127	665	911,785	677	917,537	693	1,009,557
Arizona	17	23,746	17	31,432	20	30,469	15	17,721
Arkansas	3,948	3,620,354	4,000	3,317,410	4,000	3,162,057	4,102	3,150,508
California	25,622	34,955,831	26,444	35,563,813	28,016	37,503,478	29,460	39,280,587
Colorado	5,605	6,316,308	5,982	7,001,499	6,480	7,259,935	6,866	7,170,856
Florida	NR	NR	NR	NR	NR	NR	2	3,987
Illinois	16,751	10,040,292	16,407	8,461,222	15,700	9,441,470	25,629	10,000,000
Indiana	5,004	1,729,606	5,364	1,594,296	4,943	1,737,763	5,130	1,263,630
Kansas	38,363	25,493,168	38,692	25,827,950	54,200	27,417,150	17,020	14,542,290
Kentucky	19,129	2,005,480	19,012	1,958,015	20,000	1,796,536	18,618	1,796,536
Louisiana	20,576	14,136,304	20,041	14,152,725	19,338	13,453,243	19,547	19,931,314
Michigan	2,306	3,055,339	2,011	2,657,497	2,145	2,826,374	2,205	3,044,541
Mississippi	478	678,566	1,858	895,452	1,858 /	895,452 /	1,302	1,192,175
Missouri	487	88,053	495	85,406	323	86,780	326	79,515
Montana	2,335	1,879,426	2,424	1,947,855	2,505	2,011,555	2,532	2,017,196
Nebraska	1,450	1,654,195	1,478	1,598,224	1,487	1,579,404	1,473	1,634,975
Nevada	NR	NR	NR	NR	NR	NR	33	59,203
New Mexico	13,882	13,990,201	14,069	14,065,576	14,552	14,361,916	14,975	14,832,271
New York	2,759	171,760	2,553	211,292	2,793	293,651	3,559	386,887
North Dakota	1,392	2,205,309	1,416	2,217,706	1,457	2,309,795	1,471	2,370,729
Ohio	28,918	4,868,915	28,828	4,840,874	28,915	4,805,142	29,120	4,522,244
Oklahoma	48,250	41,427,782	46,798	39,318,486	47,153	30,258,650	45,892	27,911,928
Pennsylvania	16,061	3,669,959	16,662	3,652,770	17,350	3,626,000	18,200	3,600,000
South Dakota	20	35,452	27	54,169	27	54,169	30	63,054
Tennessee	390	261,984	290	235,127	347	126,956	347	126,956
Texas	121,490	126,260,710	124,116	139,959,142	130,553	147,506,457	130,106	119,683,522
Utah	1,111	1,523,025	1,163	1,618,810	1,407	1,817,620	1,412	2,271,425
Virginia	6	1,974	3	1,233	3	779	3	1,698
West Virginia	8,000	1,200,000	7,900	1,300,000	3,668	970,802	3,897	838,947
Wyoming	12,343	8,487,256	12,357	8,281,804	12,464	8,245,343	12,572	8,263,340
TOTALS	**397,362**	**310,922,122**	**401,072**	**321,761,570**	**422,381**	**324,496,483**	**396,537**	**291,067,592**

* Numbers are estimates by states, survey respondents are listed in acknowledgement section

/ no data submitted for 2006, 2005 data used

NR - No response, new to this portion of the survey

marginal gas

marginal gas

Marginal gas is natural gas produced from a well that operates on the lower edge of profitability. Generally speaking, these are low-volume "stripper" gas wells – defined by the IOGCC as a natural gas well that produces 60 thousand cubic feet (Mcf) per day or less.

Marginal gas wells produced more than 1.76 trillion cubic feet (Tcf) during 2007. The number of gas wells in the marginal category has steadily increased during the past decade. After production declined slightly in 2006, marginal gas increased in 2007 in the number of wells and the amount of gas produced.

As with marginal oil wells, "abandoned" natural gas wells are those that have been permanently plugged.

National Marginal Natural Gas Well Survey
2007 Calendar Year

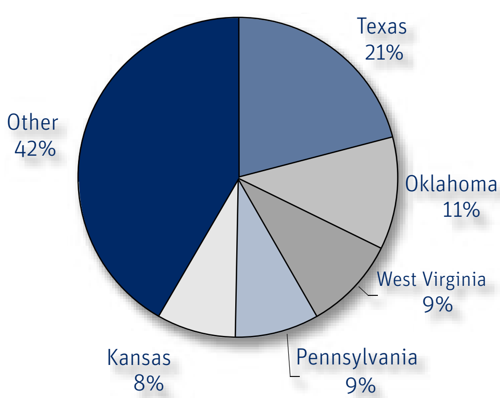
State	Number of Marginal Wells	Production from Marginal Gas Wells (Mcf)	Gas Wells Plugged and Abandoned	Average Daily Production Per Well (Mcf)	Total 2007 Gas Production (Mcf)
Alabama	3,359 **	35,753,795 **	17	29.2	285,083,044
Arizona	3	28,470	0	26.0	654,206
Arkansas	2,018	23,851,578	73	32.4	271,728,715
California	618	5,087,304	106	22.6	93,248,806
Colorado	10,740	102,321,123	53	26.1	1,249,736,112
Illinois	730	184,000	10	0.9	347,000
Indiana	450	1,802,991	9	11.0	3,605,982
Kansas	15,110	141,869,241	136	25.72	371,770,690
Kentucky	16,618	84,669,314	43	14.0	95,262,505
Louisiana	10,226	44,410,061	277	11.9	1,281,703,000
Maryland	10	39,613	0	10.9	39,613
Michigan	7,080	80,800,000	47	31.3	155,000,000
Mississippi	1,123	9,729,948	48	23.7	278,525,561
Montana	4,926	31,373,986	182	17.4	95,473,579
Nebraska	190	1,233,935	0	17.8	1,331,125
New Mexico	12,267	105,336,679	244	23.5	1,294,060,970
New York	6,066	11,411,681	19	5.2	54,916,124
North Dakota	135	1,181,897	11	24.0	17,005,562
Ohio	33,960	67,630,326	386	5.5	88,094,732
Oklahoma	22,038	195,509,065	343	24.3	1,582,414,330
Pennsylvania	52,700	152,200,000	195	7.9	182,277,000
South Dakota	63	399,907	0	17.4	422,273
Tennessee	298	1,792,984	125	16.5	3,941,785
Texas	45,119	373,718,449	249	22.7	6,225,942,181
Utah	1,797	17,781,462	42	27.1	350,005,102
Virginia	482	3,625,593	0	20.6	112,056,643
West Virginia	44,420	165,994,559	248	10.2	231,537,592
Wyoming	29,614	103,854,785	468	9.6	1,926,000,000
TOTALS	**322,160**	**1,763,592,746**	**3,331**	**15.0**	**16,252,184,232•**

* Numbers are estimates by states, survey respondents are listed in acknowledgement section
** Includes Natural Gas From Coal Seams
• This figure represents only states with Marginal natural gas production; does not include production figures from states without Marginal natural gas production.

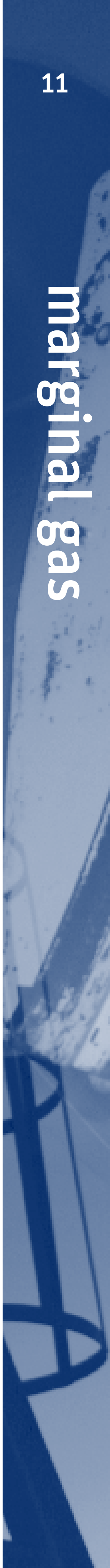
U.S. State Rankings

Number of Marginal Wells	Production from Marginal Gas Wells (Mcf)	Gas Wells Plugged and Abandoned	Average Daily Production Per Well (Mcf)
Pennsylvania	Texas	Wyoming	Arkansas
Texas	Oklahoma	Ohio	Michigan
West Virginia	West Virginia	Oklahoma	Alabama
Ohio	Pennsylvania	Louisiana	Utah
Wyoming	Kansas	Texas	Colorado
Oklahoma	New Mexico	West Virginia	Arizona
Kentucky	Wyoming	New Mexico	Kansas
Kansas	Colorado	Pennsylvania	Oklahoma
New Mexico	Kentucky	Montana	North Dakota
Colorado	Michigan	Kansas	Mississippi
Louisiana	Ohio	Tennessee	New Mexico
Michigan	Louisiana	California	Texas
New York	Alabama	Arkansas	California
Montana	Montana	Colorado	Virginia
Alabama	Arkansas	Mississippi	Nebraska
Arkansas	Utah	Michigan	Montana
Utah	New York	Kentucky	South Dakota
Mississippi	Mississippi	Utah	Tennessee
Illinois	California	New York	Kentucky
California	Virginia	Alabama	Louisiana
Virginia	Indiana	North Dakota	Indiana
Indiana	Tennessee	Illinois	Maryland
Tennessee	Nebraska	Indiana	West Virginia
Nebraska	North Dakota	Arizona	Wyoming
North Dakota	South Dakota	Maryland	Pennsylvania
South Dakota	Illinois	Nebraska	Ohio
Maryland	Maryland	South Dakota	New York
Arizona	Arizona	Virginia	Illinois

Production from Marginal Gas Wells (Mcf)



State	Production from Marginal Gas Wells (Mcf)
Texas	373,718,449
Oklahoma	195,509,065
West Virginia	165,994,559
Pennsylvania	152,200,000
Kansas	141,869,241
Other	734,301,432



Comparative Number of Marginal Wells and Marginal Gas Production 2004-2007

State	2004 Number of Marginal Wells	2004 Production from Marginal Wells (Mcf)	2005 Number of Marginal Wells	2005 Production from Marginal Wells (Mcf)	2006 Number of Marginal Wells	2006 Production from Marginal Wells (Mcf)	2007 Number of Marginal Wells	2007 Production from Marginal Wells (Mcf)
Alabama	2,194 **	22,895,790**	2,620 **	26,757,739**	3,069 **	30,156,913 **	3,359 **	35,753,795**
Arizona	2	10,987	2	17,212	3	43,494	3	28,470
Arkansas	1,913 *	16,923,448	2,114	18,707,824	2,188	18,700,000	2,018	23,851,578
California	490	4,247,011	527	4,428,540	566	4,505,285	618	5,087,304
Colorado	7,780	79,619,265	8,861	88,788,233	9,599	94,485,949	10,740	102,321,123
Illinois	409	184,000	551	184,000	551 /	184,000 /	730	184,000
Indiana	2,386	3,401,445	2,110	3,134,583	479	1,460,491	450	1,802,991
Kansas	8,169	101,394,727	15,120	283,712,000	13,868	178,670,000	15,110	141,869,241
Kentucky	16,495	83,777,212	16,618	82,323,314	17,500	91,500,000	16,618	84,669,314
Louisiana	9,784	44,477,263	10,035	42,130,824	9,942	52,154,475	10,226	44,410,061*
Maryland	7	33,391	7	36,468	8	20,878	10	39,613
Michigan	5,396	70,864,267	6,003	77,388,412	6,448	80,800,000	7,080	80,800,000
Mississippi	548	6,345,386	1,226	9,486,746	1,226 /	9,486,746 /	1,123	9,729,948
Montana	3,926	26,484,418	4,162	27,426,557	4,577	28,935,586	4,926	31,373,986
Nebraska	102	782,502	108	720,360	109	823,851	190	1,233,935
New Mexico	10,142	91,910,687	10,858	97,358,159	11,433	101,488,431	12,267	105,336,679
New York	5,710	10,261,189	5,607	9,896,329	5,516	10,170,315	6,066	11,411,681
North Dakota	58	300,815	68	401,057	88	691,183	135	1,181,897
Ohio	33,404	72,539,000	33,355	68,267,000	33,576	71,382,588	33,960	67,630,326
Oklahoma	23,845 **	203,812,145**	18,706 **	169,439,950**	20,528 **	184,790,656 **	22,038 **	195,509,065**
Pennsylvania	43,906	136,394,002	46,654	151,651,000	49,750	156,705,000	52,700	152,200,000
South Dakota	57	455,296	50	399,891	50	399,891	63	399,907
Tennessee	270	1,936,268	315	2,200,000	298	1,792,984	298	1,792,984
Texas	35,240	284,361,426	37,396	302,083,547	40,099	320,508,067	45,119	373,718,449
Utah	1,225	12,854,032	1,419	14,429,074	1,587	15,962,409	1,797	17,781,462
Virginia	228	3,050,649	285	3,651,691	357	2,404,616	482	3,625,593
West Virginia	38,500	185,000,000	40,900	186,000,000	43,336	158,446,233	44,420	165,994,559
Wyoming	19,670 **	75,643,874**	23,221 **	89,043,042**	27,249	99,649,661	29,614 **	103,854,785**
TOTALS	**271,856**	**1,539,960,495**	**288,898**	**1,760,063,552**	**304,000**	**1,716,319,702**	**322,160**	**1,763,592,746**

* Estimated
** Includes natural gas from coal seams
/ no data submitted for 2006, 2005 data used

economic analysis

economic impact of marginal wells in the United States

Steven C. Agee, Ph.D.
David L. May, Ph.D.
Jacob T. Dearmon, Ph.D.
Oklahoma City University

Generally speaking, low-volume "stripper" wells – defined by the Interstate Oil and Gas Compact Commission (IOGCC) as those wells producing 10 barrels of oil per day or less – fall into the marginal category. The IOGCC has monitored production from these wells since the 1940s.

The United States is by far the largest producer of marginal oil and gas resources, which are prime examples of conservation. While each individual well contributes only a small amount of oil (2 barrels per day in 2007), there are more than 396,000 of these wells in the United States. Combined, these marginal wells produced more than 291 million barrels of oil in 2007 – almost 28 percent of U.S. production in the lower 48 states[1]. Marginal gas is natural gas produced from a well that is defined by the IOGCC as a natural gas well that produces 60 thousand cubic feet (60 Mcf) per day or less. Marginal gas wells numbered more than 322,000 in 2007 and produced more than 1.763 trillion cubic feet (1.763 Tcf) of natural gas during that period – about 11 percent of total U.S. production in the lower 48 states[2]. Clearly, production from marginal wells is a significant factor in the overall domestic energy picture.

1 According to IOGCC survey estimates for total oil production from the lower 48 states.
2 According to IOGCC survey estimates for total gas production from the lower 48 states.

The Energy Policy Act of 2005 provides little encouragement for producers of these marginal wells by allowing royalty relief for production from federal lands. But this occurs only if prices fall below $15 per barrel or $2 per mmbtu – prices unlikely to occur even in these difficult economic times. There is no consistent governmental incentive at the state level for these mainly small producers; primarily incentives in the form of severance tax relief. Later in this report we show the economic impact of these wells on jobs and productivity in states and across the country.

Several states have enacted individual incentive programs intended to promote production from these marginal wells. But there is no broad agreement toward the necessity of these incentives. In the face of lower crude oil and natural gas prices, many of these wells may become abandoned, their contribution to domestic production levels halted. Production from these wells is, by definition, marginal. As the country attempts to expand its level of energy independence, small marginal well operators can supply jobs and boost tax revenues that increase many states' budgets. The aggregate influence of these marginal wells is quite significant in terms of revenue, employment, and earnings as discussed below. If the country wishes to expand its level of energy independence, these small operators can supply thousands of local jobs, and the tax revenues generated by production can assist many state budgets. What follows is a summary of these benefits and potential losses.

development of the report

The IOGCC surveys its member states annually to acquire data related to marginal well production. While individual states report the same information including production figures, number of wells, and types of wells, each state has its own approach for calculating these various measures. These approaches may also vary over time. Thus, while year to year comparisons of these reports are useful, the differences in data reporting and collection should be noted.

Production figures, taxes, numbers of wells producing or abandoned and other information gathered from this survey are used here. There are many other groups and government agencies that collect data related to the oil and gas industry, particularly pricing information.

Table 1.1- Marginal Oil

State	No. Marginal Oil Wells Wells	2007 Production from Marginal Oil Wells (BBLS)	2007 Abandonments	2007 Average Daily Production Per Well BOPD
California	29,460	39,280,587	2,013	3.7
Colorado	6,866	7,170,856	51	2.9
Kansas	17,020	14,542,290	749	2.3
Louisiana	19,547	19,931,314	514	2.8
Mississippi	1,302	1,192,175	43	2.5
New Mexico	14,975	14,832,271	331	2.7
North Dakota	1,471	2,370,729	7	4.4
Oklahoma	45,892	27,911,928	747	1.7
Texas	130,106	119,683,522	4,781	2.5
Utah	1,412	2,271,425	83	4.4
Wyoming	12,572	8,263,340	238	1.8
SUBTOTAL	280,623	257,450,437	9,557	2.9
ALL OTHERS	115,914	33,617,155	2,082	0.8
TOTAL	396,537	291,067,592	11,639	2.0

Table 1.2- Marginal Gas

State	No. Marginal Gas Wells Wells	2007 Production from Marginal Gas Wells (MCF)	2007 Abandonments	2007 Average Daily Production Per Well MCFD
California	618	5,087,304	106	22.6
Colorado	10,740	102,321,123	53	26.1
Kansas	15,110	141,869,241	136	25.7
Louisiana	10,226	44,410,061	277	11.9
Mississippi	1,123	9,729,948	48	23.7
New Mexico	12,267	105,336,679	244	23.5
North Dakota	135	1,181,897	11	24.0
Oklahoma	22,038	195,509,065	343	24.3
Texas	45,119	373,718,449	249	22.7
Utah	1,797	17,781,462	42	27.1
Wyoming	29,614	103,854,785	468	9.6
SUBTOTAL	148,787	1,100,800,014	1,977	21.9
ALL OTHERS	173,373	662,792,732	1,354	10.5
TOTAL	322,160	1,763,592,746	3,331	15.0

Table 1.3-Marginal Oil & Gas

	No. of Marginal Wells	2007 Abandonments
SUBTOTAL	429,410	11,534
ALL OTHERS	289,287	3,436
TOTAL	718,697	14,970

For that reason, this report uses sound statistical methodology where anomalies in collection practices exist. While year to year comparisons of this report are useful, these differences in data reporting and collection should be noted.

wellhead prices for oil and natural gas

Table 2 contains pricing information taken from the Energy Information Administration (EIA)[3]. Multiplying each state's total production volume by its own respective price, we obtain a total production value for both oil and natural gas. If the price is not available, then the state's volume is multiplied by the U.S. average price (excluding the price for Alaska and off-shore). Calculated this way, the total value of oil produced domestically is nearly $70 billion while the total value of domestic natural gas is more than $100 billion.

3 While individual wellhead prices were available on a state-by-state basis, the natural gas prices were not. Consequently, we took each state's price for 2006 and multiplied by the ratio of the 2007 U.S. average price to the 2006 U.S. average price to obtain a state price estimate for 2007.

Table 2

State	Total Oil Value $ X 1,000	Total Oil Production BBL X 1,000	Weighted Average Wellhead $/BBL	Total Gas Value $ X 1,000	Total Gas Production MCF X 1,000	Weighted Average Wellhead $/MCF
California	15,824,023	243,185	65.07	602,377	93,249	6.46
Colorado	1,549,388	23,111	67.04	7,636,434	1,249,736	6.11
Kansas	2,448,334	36,624	66.85	2,082,375	371,771	5.60
Louisiana	3,760,224	52,495	71.63	8,868,323	1,281,703	6.92
Mississippi	1,400,106	20,395	68.65	1,902,138	278,526	6.83
New Mexico	3,673,715	53,289	68.94	7,984,801	1,294,061	6.17
North Dakota	3,133,044	47,979	65.3	110,703	17,006	6.51
Oklahoma	3,417,720	49,311	69.31	9,985,232	1,582,414	6.31
Texas	23,313,601	341,341	68.3	41,027,013	6,225,942	6.59
Utah	1,219,811	19,523	62.48	1,991,912	350,005	5.69
Wyoming	3,149,527	53,986	58.34	11,249,495	1,926,000	5.84
SUBTOTAL	62,889,491	941,239	---	93,440,804	14,670,412	---
ALL OTHERS	6,863,770	102,709	---	10,609,782	1,551,658	---
TOTAL	69,753,261	1,025,263	---	104,050,586	16,252,184	---

effects of marginal oil and natural gas well abandonment

Tables 3A.1, 3A.2, and 3A.3 display the revenue impact of marginal wells abandoned during 2007. Taking output and price information from Tables 1 and 2, we find that marginal oil well abandonment reduced production by 10.14 million barrels and slashed revenue produced domestically by nearly $650 million. Similarly, marginal gas well abandonment decreased volume by nearly 20 Bcf and lowered revenues by more than $117 million. Thus, the combined loss for marginal oil and natural gas well abandonments last year exceeded three quarters of a billion dollars[4].

4 A caveat is necessary. By associating production rates of current marginal wells with those that were abandoned our volumes might be overstated.

Another manner of understanding the importance of marginal wells to the United States' economy is to examine the hypothetical scenario of abandoning all marginal wells. We do exactly this in Tables 3B.1, 3B.2, and 3B.3. The losses, both in terms of volumes and revenue, are staggering and serve to underscore the importance of marginal wells. If all marginal oil wells were abandoned, this would reduce production by nearly 300 million barrels of oil and would eliminate $18.5 billion of revenue. Likewise for natural gas, we see that production would be cut by 1.763 Tcf which corresponds to a loss of $12 billion in revenue.

table 3A: effect of 2007 abandonments

Table 3A.1: Oil

State	No. Marginal Oil Wells	2007 Production from Marginal Oil Wells (BBLS)	2007 Abandonments	2007 Average Daily Production Per Well BOPD	Lost Annual Production (BBLS)	2007 Average ($/BBL)	2007 Lost Gross Revenue
California	29,460	39,280,587	2,013	3.7	2,684,040	65.07	174,650,490
Colorado	6,866	7,170,856	51	2.9	53,264	67.04	3,570,848
Kansas	17,020	14,542,290	749	2.3	639,963	66.85	42,781,546
Louisiana	19,547	19,931,314	514	2.8	524,106	71.63	37,541,696
Mississippi	1,302	1,192,175	43	2.5	39,373	68.65	2,702,950
New Mexico	14,975	14,832,271	331	2.7	327,845	68.94	22,601,647
North Dakota	1,471	2,370,729	7	4.4	11,282	65.30	736,683
Oklahoma	45,892	27,911,928	747	1.7	454,332	69.31	31,489,760
Texas	130,106	119,683,522	4,781	2.5	4,398,006	68.30	300,383,784
Utah	1,412	2,271,425	83	4.4	133,519	62.48	8,342,243
Wyoming	12,572	8,263,340	238	1.8	156,433	58.34	9,126,298
SUBTOTAL	280,623	257,450,437	9,557	---	9,422,163	---	633,927,944
ALL OTHERS	115,914	33,617,155	2,082	---	715,632	---	10,770,325
TOTAL	396,537	291,067,592	11,639	---	10,137,794	---	644,698,269

Table 3A.2: Gas

State	No. Marginal Gas Wells	2007 Production from Marginal Gas Wells (MCF)	2007 Abandonments	2007 Average Daily Production Per Well MCFD	Lost Annual Production MCF	2007 Average $/MCF	2007 Lost Gross Revenue
California	618	5,087,304	106	22.6	872,580	6.46	5,636,769
Colorado	10,740	102,321,123	53	26.1	504,937	6.11	3,085,384
Kansas	15,110	141,869,241	136	25.7	1,276,917	5.60	7,152,312
Louisiana	10,226	44,410,061	277	11.9	1,202,972	6.92	8,323,567
Mississippi	1,123	9,729,948	48	23.7	415,884	6.83	2,840,200
New Mexico	12,267	105,336,679	244	23.5	2,095,227	6.17	12,928,271
North Dakota	135	1,181,897	11	24.0	96,303	6.51	626,913
Oklahoma	22,038	195,509,065	343	24.3	3,042,908	6.31	19,201,131
Texas	45,119	373,718,449	249	22.7	2,062,455	6.59	13,590,932
Utah	1,797	17,781,462	42	27.1	415,593	5.69	2,365,181
Wyoming	29,614	103,854,785	468	9.6	1,641,252	5.84	9,586,323
SUBTOTAL	148,787	1,100,800,014	1,977	---	13,627,027	---	85,336,982
ALL OTHERS	173,373	662,792,732	1,354	---	6,044,223	---	32,156,803
TOTAL	322,160	1,763,592,746	3,331	---	19,671,250	---	117,493,784

Table 3A.3: Oil & Gas

	No. Marginal Wells	2007 Abandonments	2007 Lost Gross Revenue
SUBTOTAL	429,410	11,534	719,264,926
ALL OTHERS	289,287	3,436	42,927,128
TOTAL	718,697	14,970	762,192,054

table 3B: effect of hypothetical 2007 abandonment of all marginal wells

Table 3B.1: Oil

State	No. Marginal Oil Wells	2007 Production from Marginal Oil Wells (Bbls.)	Hypothetical Abandonments	2007 Average Daily Production Per Well BOPD	Lost Annual Production BBLS	2007 Average $/BBL	Hypothetical 2007 Lost Gross Revenue
California	29,460	39,280,587	29,460	3.7	39,280,587	65.07	2,555,987,796
Colorado	6,866	7,170,856	6,866	2.9	7,170,856	67.04	480,734,186
Kansas	17,020	14,542,290	17,020	2.3	14,542,290	66.85	972,152,087
Louisiana	19,547	19,931,314	19,547	2.8	19,931,314	71.63	1,427,680,022
Mississippi	1,302	1,192,175	1,302	2.5	1,192,175	68.65	81,842,814
New Mexico	14,975	14,832,271	14,975	2.7	14,832,271	68.94	1,022,536,763
North Dakota	1,471	2,370,729	1,471	4.4	2,370,729	65.30	154,808,604
Oklahoma	45,892	27,911,928	45,892	1.7	27,911,928	69.31	1,934,575,730
Texas	130,106	119,683,522	130,106	2.5	119,683,522	68.30	8,174,384,553
Utah	1,412	2,271,425	1,412	4.4	2,271,425	62.48	141,918,634
Wyoming	12,572	8,263,340	12,572	1.8	8,263,340	58.34	482,083,256
SUBTOTAL	280,623	257,450,437	280,623	---	257,450,437	---	17,428,704,443
ALL OTHERS	115,914	33,617,155	115,914	---	33,617,155	---	1,127,706,640
TOTAL	396,537	291,067,592	396,537	---	291,067,592	---	18,556,411,083

Table 3B.2: Gas

State	No. Marginal Gas Wells	2007 Production from Marginal Gas Wells (MCF)	Hypothetical Abandonments	2007 Average Daily Production Per Well MCFD	Lost Annual Production MCF	2007 Average $/MCF	Hypothetical 2007 Lost Gross Revenue
California	618	5,087,304	618	22.6	5,087,304	6.46	32,863,427
Colorado	10,740	102,321,123	10,740	26.1	102,321,123	6.11	625,226,827
Kansas	15,110	141,869,241	15,110	25.7	141,869,241	5.60	794,642,869
Louisiana	10,226	44,410,061	10,226	11.9	44,410,061	6.92	307,280,845
Mississippi	1,123	9,729,948	1,123	23.7	9,729,948	6.83	66,448,856
New Mexico	12,267	105,336,679	12,267	23.5	105,336,679	6.17	649,963,519
North Dakota	135	1,181,897	135	24.0	1,181,897	6.51	7,693,928
Oklahoma	22,038	195,509,065	22,038	24.3	195,509,065	6.31	1,233,686,639
Texas	45,119	373,718,449	45,119	22.7	373,718,449	6.59	2,462,687,792
Utah	1,797	17,781,462	1,797	27.1	17,781,462	5.69	101,195,967
Wyoming	29,614	103,854,785	29,614	9.6	103,854,785	5.84	606,601,195
SUBTOTAL	148,787	1,100,800,014	148,787	---	1,100,800,014	---	6,888,291,864
ALL OTHERS	173,373	662,792,732	173,373	---	662,792,732	---	5,132,189,735
TOTAL	322,160	1,763,592,746	322,160	---	1,763,592,746	---	12,020,481,599

Table 3B.3: Oil & Gas

	No. Marginal Wells	Hypothetical Abandonments	2007 Lost Gross Revenue
SUBTOTAL	429,410	429,410	24,316,996,307
ALL OTHERS	289,287	289,287	6,259,896,375
TOTAL	718,697	718,697	30,576,892,682

the use of economic multipliers

The RIMS II multipliers, which are used to quantify the economic impact of the marginal gas and oil well abandonments, are listed in Table 4. These values are taken from last years' report.

Holding price levels constant, these multipliers represent the regional economic impact that results from a change in demand, which, in this case, is the revenue lost from abandonment.

In the first three columns, the final demand multipliers for output, earnings and employment include not only effects for the oil and gas industry, but secondary and supporting industries as well. Examples of these secondary industries may include, but are not limited to, industries such as healthcare and retail. Please refer to the Appendix for a more thorough discussion of the multiplier concept.

The direct effect multipliers are listed in the next two columns. While these are not directly relevant to this report, they are used in calculating the oil and gas industry specific multipliers (columns 6 and 7). These industry specific multipliers are smaller than the final demand multipliers listed in columns 1-3, and will allow us to calculate the impact of the abandonments on just the oil and gas industry.

Table 4: RIMS II Multipliers

State	Final Demand Multipliers: Output	Final Demand Multipliers: Earnings	Final Demand Multipliers: Employment	Direct Effect Multipliers: Earnings	Direct Effect Multipliers: Employment	Calculated O & G Industry Multipliers: Earnings	Calculated O & G Industry Multipliers: Employment
California	1.989	0.432	9.5	2.410	2.760	0.179	3.451
Colorado	2.063	0.434	8.6	2.539	4.579	0.171	1.886
Kansas	1.947	0.379	14.1	2.200	2.027	0.172	6.962
Louisiana	1.832	0.363	8.8	2.310	3.789	0.157	2.328
Mississippi	1.605	0.304	9.3	2.066	2.429	0.147	3.837
New Mexico	1.656	0.349	10	2.036	2.681	0.171	3.742
North Dakota	1.744	0.354	11	2.023	2.425	0.175	4.531
Oklahoma	2.04	0.422	11.5	2.389	3.682	0.177	3.114
Texas	2.085	0.433	8.4	2.473	5.381	0.175	1.568
Utah	1.895	0.402	11.6	2.439	3.128	0.165	3.703
Wyoming	1.734	0.324	7.9	1.897	2.957	0.171	2.675

impact of marginal oil and natural gas production on the U.S. economy

Tables 5A and 5B evaluate the economic impact associated with abandonments listed in Tables 3A and 3B, respectively. Using the RIMS II multipliers from Table 4, the total estimated economic impact of actual marginal well abandonments is displayed in Table 5A. These abandonments caused the loss of an estimated 7,215 jobs, more than $315 million in earnings, and $1.5 billion in output. Given that these numbers are based on the final demand multipliers, the lost jobs will occur not only in the oil and gas industry but also in the secondary and supporting industries as well. In just the oil and gas industry, the effect of abandonments is $133 million in lost employment earnings and 2,121 in lost jobs.

The losses are even more pronounced when we consider the abandonment of all marginal wells. Table 5B displays the outcome under this hypothetical scenario. **In this case, the lost output is $61 billion, lost earnings are $12.5 billion, and 292,374 individuals are estimated to lose their jobs. In the oil and gas industry alone, the effect of abandonments is $5.3 billion in lost worker earnings and 83,000 potential jobs lost.**

table 5A: economic effects of 2007's abandonments

Table 5A.1: Oil

State	2007 Revenue Lost from Abandonment Million $	Final Demand Multipliers Output	Final Demand Multipliers Earnings	Final Demand Multipliers Employment	Lost Output Million $	Lost Earnings Million $	Lost Employment Multipliers	Direct Effect Multipliers Earnings	Direct Effect Million $ Employment	Lost Earnings	Lost Employment
California	174.650	1.989	0.432	9.5	347.397	75.432	1659	0.179	3.451	31.297	602.65
Colorado	3.571	2.063	0.434	8.6	7.366	1.549	31	0.171	1.886	0.610	6.73
Kansas	42.782	1.947	0.379	14.1	83.279	16.206	603	0.172	6.962	7.367	297.84
Louisiana	37.542	1.832	0.363	8.8	68.780	13.620	330	0.157	2.328	5.894	87.38
Mississippi	2.703	1.605	0.304	9.3	4.338	0.820	25	0.147	3.837	0.397	10.37
New Mexico	22.602	1.656	0.349	10	37.435	7.881	226	0.171	3.742	3.869	84.58
North Dakota	0.737	1.744	0.354	11	1.285	0.261	8	0.175	4.531	0.129	3.34
Oklahoma	31.490	2.04	0.422	11.5	64.239	13.301	362	0.177	3.114	5.567	98.07
Texas	300.384	2.085	0.433	8.4	626.390	130.186	2523	0.175	1.568	52.657	470.85
Utah	8.342	1.895	0.402	11.6	15.808	3.352	97	0.165	3.703	1.375	30.89
Wyoming	9.126	1.734	0.324	7.9	15.829	2.959	72	0.171	2.675	1.560	24.42
SUBTOTAL	633.928	2.007	0.419	9.365	1272.145	265.566	5937	0.175	2.709	110.723	1,717.11
ALL OTHERS	10.770	2.007	0.419	9.365	21.614	4.512	101	0.175	2.709	1.881	29.17
TOTAL	644.698	2.007	0.419	9.365	1293.759	270.078	6038	0.175	2.709	112.604	1,746.28

Table 5A.2: Gas

State	2007 Revenue Lost from Abandonment Million $	Final Demand Multipliers Output	Final Demand Multipliers Earnings	Final Demand Multipliers Employment	Lost Output Million $	Lost Earnings Million $	Lost Employment	Direct Effect Multipliers Earnings	Direct Effect Multipliers Employment	Lost Earnings Million $	Lost Employment
California	5.637	1.989	0.432	9.5	11.212	2.435	54	0.179	3.451	1.010	19.45
Colorado	3.085	2.063	0.434	8.6	6.364	1.338	27	0.171	1.886	0.527	5.82
Kansas	7.152	1.947	0.379	14.1	13.923	2.709	101	0.172	6.962	1.232	49.79
Louisiana	8.324	1.832	0.363	8.8	15.250	3.020	73	0.157	2.328	1.307	19.37
Mississippi	2.840	1.605	0.304	9.3	4.558	0.862	26	0.147	3.837	0.417	10.90
New Mexico	12.928	1.656	0.349	10	21.413	4.508	129	0.171	3.742	2.213	48.38
North Dakota	0.627	1.744	0.354	11	1.093	0.222	7	0.175	4.531	0.110	2.84
Oklahoma	19.201	2.04	0.422	11.5	39.170	8.111	221	0.177	3.114	3.395	59.80
Texas	13.591	2.085	0.433	8.4	28.341	5.890	114	0.175	1.568	2.382	21.30
Utah	2.365	1.895	0.402	11.6	4.482	0.950	27	0.165	3.703	0.390	8.76
Wyoming	9.586	1.734	0.324	7.9	16.627	3.108	76	0.171	2.675	1.638	25.65
SUBTOTAL	85.337	1.903	0.388	10.018	162.433	33.153	855	0.171	3.188	14.621	272.06
ALL OTHERS	32.157	1.903	0.388	10.018	61.208	12.493	322	0.171	3.188	5.510	102.52
TOTAL	117.494	1.903	0.388	10.018	223.641	45.645	1177	0.171	3.188	20.131	374.58

Table 5A.3: Oil & Gas

State	2007 Revenue Lost from Abandonment Million $	Final Demand Multipliers Output	Final Demand Multipliers Earnings	Final Demand Multipliers Employment	Lost Output Million $	Lost Earnings Million $	Lost Employment	Direct Effect Multipliers Earnings	Direct Effect Multipliers Employment	Lost Earnings Million $	Lost Employment
SUBTOTAL	719.265	1.995	0.415	9.443	1,434.578	298.719	6,791.873	0.174	2.766	125.344	1,989.17
ALL OTHERS	42.927	1.995	0.415	9.443	82.822	17.005	423.019	0.174	2.766	7.391	131.69
TOTAL	762.192	1.995	0.415	9.443	1,517.400	315.724	7,214.892	0.174	2.766	132.734	2,120.86

table 5B: economic effects of 2007 hypothetical abandonment of all marginal wells

Table 5B.1: Oil

State	2007 Revenue Lost from Abandonment Million $	Final Demand Multipliers Output	Final Demand Multipliers Earnings	Final Demand Multipliers Employment	Lost Output Million $	Lost Earnings Million $	Lost Employment Multipliers	Direct Effect Multipliers Earnings	Direct Effect Million $ Employment	Lost Earnings	Lost Employment
California	2,555.988	1.989	0.432	9.5	5084.115	1103.931	24282	0.179	3.451	458.033	8,820
Colorado	480.734	2.063	0.434	8.6	991.610	208.494	4134	0.171	1.886	82.109	907
Kansas	972.152	1.947	0.379	14.1	1892.391	368.251	13707	0.172	6.962	167.405	6,768
Louisiana	1,427.680	1.832	0.363	8.8	2615.653	517.962	12564	0.157	2.328	224.146	3,323
Mississippi	81.843	1.605	0.304	9.3	131.350	24.839	761	0.147	3.837	12.023	314
New Mexico	1,022.537	1.656	0.349	10	1693.628	356.559	10225	0.171	3.742	175.058	3,826
North Dakota	154.809	1.744	0.354	11	270.002	54.771	1703	0.175	4.531	27.076	701
Oklahoma	1,934.576	2.04	0.422	11.5	3946.534	817.165	22248	0.177	3.114	342.033	6,025
Texas	8,174.385	2.085	0.433	8.4	17046.044	3542.778	68665	0.175	1.568	1432.970	12,813
Utah	141.919	1.895	0.402	11.6	268.922	57.023	1646	0.165	3.703	23.388	526
Wyoming	482.083	1.734	0.324	7.9	836.125	156.291	3809	0.171	2.675	82.388	1,290
SUBTOTAL	17,428.704	1.995	0.414	9.395	34776.374	7208.066	163744	0.174	2.600	3026.629	45,313
ALL OTHERS	1,127.707	1.995	0.414	9.395	2250.170	466.391	10595	0.174	2.600	195.835	2,932
TOTAL	18,556.411	1.995	0.414	9.395	37026.544	7674.456	174339	0.174	2.600	3222.464	48,245

Table 5B.2: Gas

State	2007 Revenue Lost from Abandonment Million $	Final Demand Multipliers Output	Final Demand Multipliers Earnings	Final Demand Multipliers Employment	Lost Output Million $	Lost Earnings Million $	Lost Employment	Direct Effect Multipliers Earnings	Direct Effect Multipliers Employment	Lost Earnings Million $	Lost Employment
California	32.863	1.989	0.432	9.5	65.369	14.194	312	0.179	3.451	5.889	113
Colorado	625.227	2.063	0.434	8.6	1289.655	271.161	5377	0.171	1.886	106.789	1,179
Kansas	794.643	1.947	0.379	14.1	1546.852	301.011	11205	0.172	6.962	136.838	5,532
Louisiana	307.281	1.832	0.363	8.8	562.969	111.481	2704	0.157	2.328	48.243	715
Mississippi	66.449	1.605	0.304	9.3	106.644	20.167	618	0.147	3.837	9.761	255
New Mexico	649.964	1.656	0.349	10	1076.535	226.642	6500	0.171	3.742	111.274	2,432
North Dakota	7.694	1.744	0.354	11	13.419	2.722	85	0.175	4.531	1.346	35
Oklahoma	1,233.687	2.04	0.422	11.5	2516.721	521.109	14187	0.177	3.114	218.116	3,842
Texas	2,462.688	2.085	0.433	8.4	5135.443	1067.329	20687	0.175	1.568	431.709	3,860
Utah	101.196	1.895	0.402	11.6	191.756	40.661	1174	0.165	3.703	16.677	375
Wyoming	606.601	1.734	0.324	7.9	1052.089	196.660	4792	0.171	2.675	103.668	1,623
SUBTOTAL	6,888.292	1.968	0.403	9.820	13557.451	2773.137	67640	0.173	2.898	1190.309	19,962
ALL OTHERS	5,132.190	1.968	0.403	9.820	10101.113	2066.153	50396	0.173	2.898	886.852	14,873
TOTAL	12,020.482	1.968	0.403	9.820	23658.564	4839.290	118036	0.173	2.898	2077.161	34,835

Table 5B.3: Oil & Gas

State	2007 Revenue Lost from Abandonment Million $	Final Demand Multipliers Output	Final Demand Multipliers Earnings	Final Demand Multipliers Employment	Lost Output Million $	Lost Earnings Million $	Lost Employment	Direct Effect Multipliers Earnings	Direct Effect Multipliers Employment	Lost Earnings Million $	Lost Employment
SUBTOTAL	24,316.996	1.988	0.410	9.515	48,333.825	9,981.203	231,383.620	0.173	2.684	4,216.938	65,275
ALL OTHERS	6,259.896	1.988	0.410	9.515	12,351.283	2,532.544	60,990.665	0.173	2.684	1,082.687	17,805
TOTAL	30,576.893	1.988	0.410	9.515	60,685.108	12,513.747	292,374.285	0.173	2.684	5,299.625	83,079

severance and ad valorem taxes

The RIMS II multipliers do not account for any tax payments, such as ad valorem or severance taxes, made to state or local authorities. We address this shortcoming by analyzing annual tax revenue generated by these marginal wells and examining the economic impact of abandonments in terms of lost tax revenue. Tax rates for the marginal wells are assumed to apply at the lowest level of marginal status granted. No additional tax reductions for secondary or tertiary marginal well state were considered.

Environmental, conservation, and maintenance taxes were also included in the calculations. The tax revenue generated by the marginal well produc-

Table 6.1: Oil

State	Marginal Oil Severance Tax Rate	Other Taxes	Weighted Average Wellhead $/BBL	2007 Production from Marginal Wells (BBLS)	Annual Total Marginal Oil Production Tax Revenue	2007 Lost Annual Production (BBLS)	Annual Lost Marginal Oil Production Tax Revenue
Alabama	6.00%	---	71.1	1,009,557	4,306,770	4,370	18,644
Alaska	15.00%	$0.03	66.4	--	---	--	---
Arizona	3.13%	---	66.4	17,721	36,771	0	0
Arkansas	4.00%	$0.05	64.3	3,150,508	8,244,879	39,938	104,518
California	0.00%	$0.06	65.1	39,280,587	2,431,036	2,684,040	166,113
Colorado	0.00%	$0.12	67.0	7,170,856	860,503	53,264	6,392
Florida	5.00%	---	66.4	3,987	13,237	3,987	13,237
Illinois	0.00%	---	65.7	10,000,000	0	282,883	0
Indiana	1.00%	---	65.5	1,263,630	827,678	89,907	58,889
Kansas	0.00%	$0.03	66.9	14,542,290	397,005	639,963	17,471
Kentucky	4.50%	---	63.6	1,796,536	5,141,686	19,009	54,405
Louisiana	3.13%	---	71.6	19,931,314	44,596,315	524,106	1,172,687
Maryland	0.00%	---	66.4	---	---	---	---
Michigan	4.00%	1.00%	66.9	3,044,541	10,183,990	84,225	281,734
Mississippi	6.00%	$0.04	68.7	1,192,175	4,966,601	39,373	164,028
Missouri	0.00%	---	66.4	79,515	0	6,586	0
Montana	0.76%	0.30%	64.640	2,017,196	1,382,150	31,867	21,835
Nebraska	2.00%	1.00%	62.8	1,634,975	3,080,293	22,199	41,823
Nevada	5.00%	---	66.4	59,203	2,960	10,764	538
New Mexico	3.75%	3.34%	68.9	14,832,271	72,455,792	327,845	1,601,527
New York	0.00%	---	69.5	386,887	0	9,892	0
North Dakota	5.00%	65.3	2,370,729	7,740,430	11,282	36,834	
Ohio	10.00%	---	68.1	4,522,244	452,224	32,923	452,224
Oklahoma	7.20%	$0.00	69.3	27,911,928	139,228,465	454,332	2,266,270
Oregon	6.00%	---	---	---	---	---	---
Pennsylvania	0.00%	70.0	3,600,000	0	25,319	0	
South Dakota	4.74%	62.8	63,054	187,694	0	0	
Tennessee	3.00%	---	66.4	126,956	252,896	45,733	91,101
Texas	4.60%	$0.19	68.3	119,683,522	398,833,369	4,398,006	14,655,914
Utah	0.00%	0.20%	62.5	2,271,425	283,928	133,519	16,690
Virginia	0.50%	---	66.4	1,698	564	0	0
West Virginia	5.00%	67.3	838,947	2,823,057	6,028	20,284	
Wyoming	4.00%	0.06%	58.3	8,263,340	19,559,161	156,433	370,274
TOTAL	---	---	---	291,067,592	728,289,454	10,137,794	21,633,431

tion is provided in Table 6. We find that oil production generates $728 million in tax revenue while an additional $22 million is lost due to real abandonments. For gas, the tax revenue is more than $600 million with $6.2 million lost due to abandonment. Thus, the production tax revenue generated by these marginal wells is a substantial $1.3 billion.

Table 6.2: Gas

State	Marginal Gas Severance Tax Rate	Other Taxes	Weighted Average Wellhead $/MCF	2007 Production from Marginal Wells (MCF)	Annual Total Marginal Gas Production Tax Revenue	2007 Lost Annual Production (MCF)	Annual Lost Marginal Gas Production Tax Revenue
Alabama	6.00%	---	7.6	35,753,795	16,214,000	180,951	82,060
Alaska	10.00%	$0.00	6.5	---	---	---	---
Arizona	3.13%	---	5.7	28,470	5,063	0	0
Arkansas	0.30%	$0.01	6.4	23,851,578	190,813	862,817	6,903
California	0.00%	$0.01	6.5	5,087,304	31,485	872,580	5,400
Colorado	0.00%	12.00%	6.1	102,321,123	75,027,219	504,937	370,246
Florida	50.90%	---	6.5	---	---	---	---
Illinois	0.00%	---	6.5	184,000	0	3,285	0
Indiana	1.00%	---	6.0	1,802,991	108,190	36,060	2,164
Kansas	0.00%	$0.01	5.6	141,869,241	822,842	1,276,917	7,406
Kentucky	4.50%	---	8.8	84,669,314	33,590,784	219,087	86,918
Louisiana	0.13%	---	6.9	44,410,061	57,733	1,202,972	1,564
Maryland	7.00%	---	7.6	39,613	2,773	0	0
Michigan	5.00%	1.00%	6.5	80,800,000	31,424,881	536,384	208,612
Mississippi	6.00%	$0.01	6.8	9,729,948	4,035,581	415,884	172,491
Missouri	0.00%	---	6.5	---	---	---	---
Montana	11.00%	0.30%	5.5	31,373,986	19,574,657	1,159,169	723,221
Nebraska	3.00%	1.00%	6.5	1,233,935	319,936	0	0
Nevada	0.10%	---	---	---	---	---	---
New Mexico	3.75%	4.19%	6.2	105,336,679	51,607,103	2,095,227	1,026,505
New York	0.00%	---	7.1	11,411,681	0	35,744	0
North Dakota	7.72%	---	6.5	1,181,897	91,242	96,303	7,435
Ohio	10.00%	---	7.7	67,630,326	6,763,033	768,708	76,871
Oklahoma	7.20%	$0.00	6.3	195,509,065	88,783,305	3,042,908	1,381,826
Oregon	6.00%	---	4.4	---	---	---	---
Pennsylvania	0.00%	---	6.5	152,200,000	0	563,169	0
South Dakota	4.74%	---	6.4	399,907	121,126	0	0
Tennessee	3.00%	---	6.8	1,792,984	364,123	752,091	152,736
Texas	7.50%	$0.00	6.6	373,718,449	185,934,855	2,062,455	1,026,126
Utah	0.00%	0.20%	5.7	17,781,462	202,392	415,593	4,730
Virginia	3.00%	---	6.5	3,625,593	705,036	0	0
West Virginia	5.00%	---	6.5	165,994,559	53,799,085	926,759	300,364
Wyoming	6.00%	0.06%	5.8	103,854,785	36,760,032	1,641,252	580,931
TOTAL	---	---	---	1,763,592,746	606,537,290	19,671,250	6,224,508

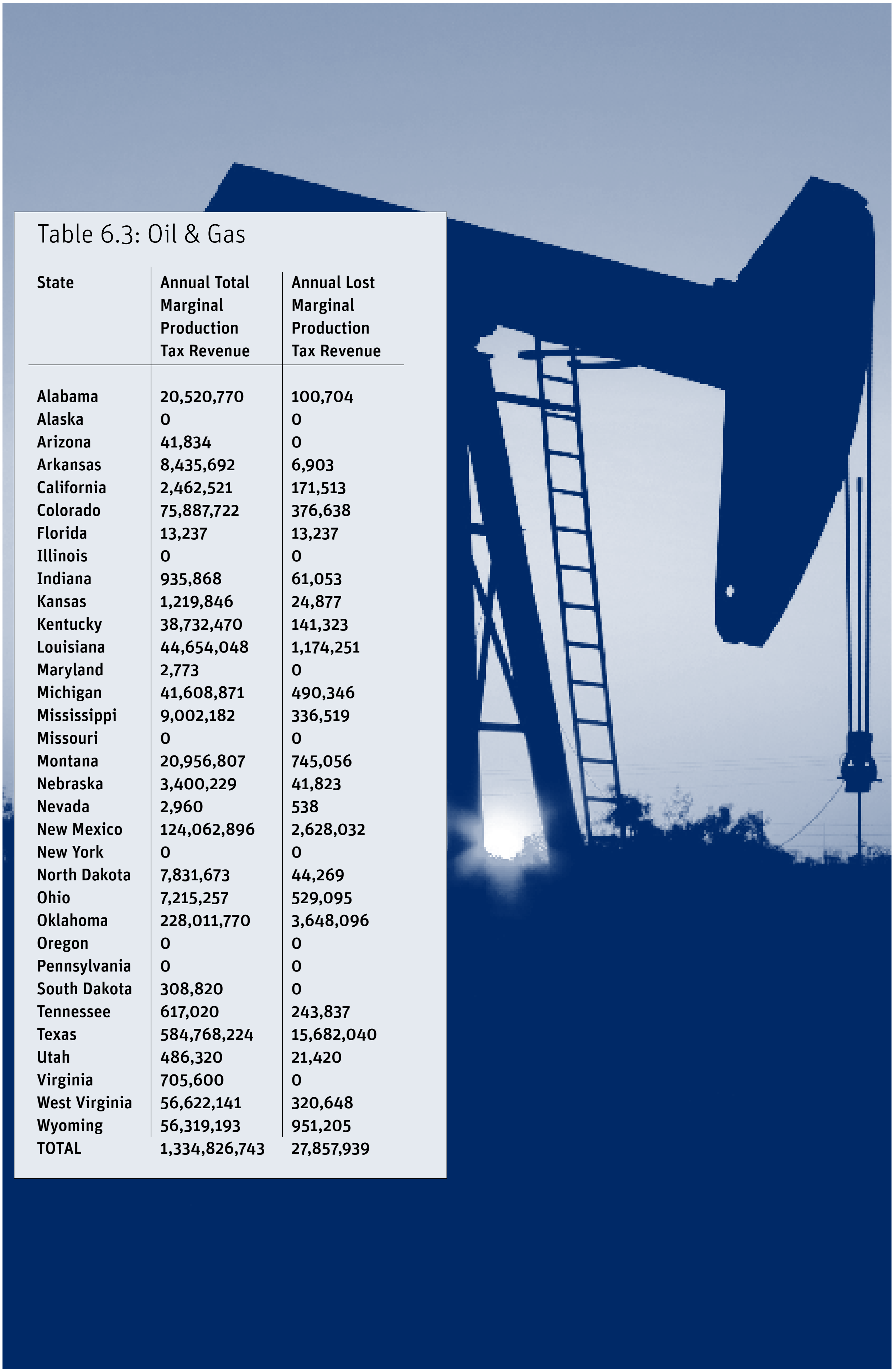


Table 6.3: Oil & Gas

State	Annual Total Marginal Production Tax Revenue	Annual Lost Marginal Production Tax Revenue
Alabama	20,520,770	100,704
Alaska	0	0
Arizona	41,834	0
Arkansas	8,435,692	6,903
California	2,462,521	171,513
Colorado	75,887,722	376,638
Florida	13,237	13,237
Illinois	0	0
Indiana	935,868	61,053
Kansas	1,219,846	24,877
Kentucky	38,732,470	141,323
Louisiana	44,654,048	1,174,251
Maryland	2,773	0
Michigan	41,608,871	490,346
Mississippi	9,002,182	336,519
Missouri	0	0
Montana	20,956,807	745,056
Nebraska	3,400,229	41,823
Nevada	2,960	538
New Mexico	124,062,896	2,628,032
New York	0	0
North Dakota	7,831,673	44,269
Ohio	7,215,257	529,095
Oklahoma	228,011,770	3,648,096
Oregon	0	0
Pennsylvania	0	0
South Dakota	308,820	0
Tennessee	617,020	243,837
Texas	584,768,224	15,682,040
Utah	486,320	21,420
Virginia	705,600	0
West Virginia	56,622,141	320,648
Wyoming	56,319,193	951,205
TOTAL	1,334,826,743	27,857,939

conclusion

According to the Energy Information Administration (EIA), the United States consumed 20.7 million barrels of crude oil per day during 2007. This report indicates that almost 4 percent of that daily consumption of oil is supplied by domestically producing marginal wells. These marginal oil wells accounted for approximately 28 percent of all domestic oil production from the lower 48 states– and a not-insignificant component of consumption here in the United States.

The EIA reports that consumption of natural gas in the United States during 2007 was slightly more than 23 trillion cubic feet (Tcf), about 70 percent of which is produced domestically. Domestic marginal gas wells supplied about 7.7 percent of our country's consumption of this clean fuel.

Marginal well operations are not only important for energy policy purposes. We find that every $1 million directly generated by activity in this type of production results in more than $2 million of activity elsewhere in the economy as companies not directly in the industry benefit from the trickle down. And we note that each additional million dollars of production from these wells employs almost 10 workers directly and indirectly; as many as 14 workers in some states.

Operations related to marginal wells remain an important part of the domestic oil and natural gas industry. Local and regional jobs are provided, state tax revenues are enhanced, and the national economy is enhanced. And marginal wells remain an important part of domestic energy policy. Every barrel of domestically produced crude oil is a barrel that does not have to be bought internationally.

While both crude oil and natural gas prices have been declining recently, most economists see that as temporary. So long as supplies of these exhaustible resources remain tight relative to demand, prices will inevitably rise. And the more importance that can be given to domestic production of hydrocarbons, the more energy independent the United States can become.

Table 7.1: Oil

Year	No. of Marginal Wells	Marginal Well Production (BBLS)	Abandonments	Avg. Daily Production Per Well (BOPD)	Lost Annual Production (Million BBLS)	Lost Output (Million $)	Lost Earnings (Million $)	Lost Employ-ment	Lost Severance Taxes
1993	452,248	355.961	16,914	2.2	15.210	357.783	47.614	2,026	10.101
1994	442,500	339.930	17,896	2.1	16.153	359.506	48.065	2,019	10.577
1995	433,048	332.288	16,389	2.1	15.322	374.833	50.019	2,133	10.310
1996	428,842	323.468	16,674	2.1	16.452	497.243	66.086	2,829	13.688
1997	420,674	322.090	15,172	2.1	14.049	387.536	51.427	2,220	9.912
1998	406,380	316.870	13,912	2.1	11.984	216.490	28.874	1,231	5.992
1999	410,680	315.514	11,227	2.1	9.616	247.871	33.059	1,483	6.140
2000	411,629	325.947	10,718	2.2	10.122	429.997	57.505	2,333	10.618
2001	403,459	316.099	12,234	2.1	11.295	397.960	53.149	2,268	8.348
2002	402,072	323.777	13,635	2.2	13.157	468.723	62.571	2,621	10.113
2003	393,463	313.748	14,300	2.2	13.844	792.388	164.696	3,783	12.534
2004	397,362	310.922	11,977	2.1	11.305	865.535	179.932	4,028	15.879
2005	401,072	321.762	13,265	2.2	12.656	1,305.654	271.524	6,321	20.533
2006	422,255	335.312	11,738	2.2	11.142	1,359.872	283.951	6,240	22.950
2007	396,537	291.068	11,639	2.0	10.000	1,293.759	270.078	6,038	21.633
TOTAL	---	4,844.756	207,690	---	192.308	9,355.150	1,668.550	47,572	189.329

Table 7.2: Gas

Year	No. of Marginal Wells	Marginal Well Production	Abandonments	Avg. Daily Production Per Well (MCFD)	Lost Annual Production (BCF)	Lost Output (Million $)	Lost Earnings (Million $)	Lost Employ-ment	Lost Severance Taxes
1993	---	---	---	---	---	---	---	---	---
1994	159,369	940.421	3,163	16.2	21.256	$61.758	$8.112	376	$1.608
1995	159,669	925.563	3,189	15.9	23.053	51.853	6.771	315	1.518
1996	168,702	986.676	4,671	16.0	39.978	137.092	18.065	804	4.860
1997	189,756	1,042.153	4,661	15.7	35.839	122.772	16.192	729	3.947
1998	199,745	1,104.684	4,203	15.6	29.258	92.721	12.286	549	3.128
1999	207,766	1,138.980	3,546	15.6	24.407	80.846	10.707	481	2.799
2000	223,222	1,258.727	3,534	15.4	23.806	412.340	85.254	1,983	10.819
2001	234,507	1,353.516	3,600	15.8	24.655	397.960	53.149	909	4.716
2002	245,961	1,418.274	3,870	15.8	27.261	128.329	16.997	765	4.335
2003	260,563	1,478.106	3,883	15.5	26.889	274.231	56.033	1,329	6.745
2004	271,856	1,478.106	3,883	15.5	28.978	312.217	64.571	1,530	8.091
2005	288,898	1,760.064	4,517	16.7	31.750	466.695	96.291	2,284	12.378
2006	296,721	1,708.408	4,463	15.8	32.124	412.340	85.254	1,983	10.819
2007	322,160	1,763.592	3,331	15.0	19.671	223.641	45.645	1,177	6.225
TOTAL	---	18,357.268	54,514	---	388.925	$3,174.796	$575.326	15,214	$81.987

Table 7.3: Oil and Gas

Year	No. of Marginal Wells	Marginal Well Production (MMBOE 6:1)	Abandonments	Avg. Daily Production Per Well (BOEPD)	Lost Annual Production (MMBOE 6:1)	Lost Output (Million $)	Lost Earnings (Million $)	Lost Employ-ment	Lost Severance Taxes
1993	452,248	355.961	16,914	2.2	15.210	357.783	47.614	2,026	10.101
1994	601,869	496.667	21,059	4.8	19.695	421.264	56.177	2,395	12.185
1995	592,717	486.549	19,578	4.7	19.164	426.686	56.790	2,448	11.828
1996	597,544	487.914	21,345	4.7	23.115	634.335	84.151	3,633	18.548
1997	610,430	495.782	19,833	4.7	20.023	510.308	67.619	2,949	13.859
1998	606,125	500.984	18,115	4.7	16.861	309.211	41.160	1,780	9.120
1999	618,446	505.344	14,773	4.7	13.684	328.717	43.766	1,964	8.939
2000	634,851	535.735	14,252	4.7	14.090	842.337	142.758	4,316	21.437
2001	637,966	541.685	15,834	4.8	15.404	795.920	106.298	3,177	13.064
2002	648,033	560.156	17,505	4.8	17.701	597.052	79.568	3,386	14.448
2003	654,026	560.099	18,183	4.8	18.326	1,066.619	220.729	5,112	19.278
2004	669,218	557.273	15,860	4.7	16.135	1,177.753	244.503	5,558	23.971
2005	689,970	615.105	17,782	5.0	17.947	1,772.349	367.814	8,605	32.911
2006	718,976	620.047	16,201	4.8	16.496	1,772.212	369.204	8,223	33.769
2007	718,697	585.000	14,970	4.5	13.279	1,517.000	316.000	7,215	27.858
TOTAL	---	7,904.301	262,204	---	257.128	12,529.546	2,244.152	62,786	271.316

technology

marginal wells — technology to the rescue

the case

The terms "stripper well" and "marginal well" interchangeably refer to an oil or natural gas well that is nearing the end of its economically useful life. Nevertheless these wells represent a key strategic element of this country's energy platform and are an important player in the call for energy diversification. These are resources that are ready and capable of meeting significant domestic energy needs with applied technology.

However, a technology innovator wishing to address the marginal well operator market is faced with daunting challenges. Scattered across the United States, operating in different geological and climatic environments, the small independent operator is hard to target. Margins on their operations are small and not well-suited to expensive technology, even if it would result in production enhancement.

In addition, federal funding for oil and natural gas research and development has been drastically reduced in recent years, making it difficult for marginal operators that do not have access to large corporate R&D departments or budgets.

Enter the Stripper Well Consortium (SWC). The mission of the Stripper Well Consortium is to focus on the development of technologies to improve the production performance of the nation's natural gas and petroleum marginal wells. Established in 2000, its member organizations include producers, service and supply companies, universities and industrial trade organizations in 20 states, the District of Columbia and Canada. The IOGCC also serves as a member of the consortium. SWC receives its funding from the U.S. Department of Energy's National Energy Technology Laboratory (NETL) and the New York State Energy Research & Development Authority (NYSERDA). The Pennsylvania State University provides management responsibilities.

SWC currently conducts research in four broad areas: reservoir remediation, wellbore liquids removal and clean-up, surface system optimization, and environmental. Collaboration among individuals and organizations is encouraged in the submission of research project proposals. Since 2000, SWC has awarded 95 projects. Participants in the projects speak to the huge value of the collaborative focus the SWC brings to these projects, linking researchers, manufacturers and operators to develop and test concepts. According to the testimony of many technology innovators, the SWC has been a pioneer in pushing technology to the forefront of the industry agenda and has been an enabling agent establishing credibility, funding and opportunity.

An overview of some of SWC's funded projects highlight the importance of technology, the challenges of moving from concept to commercial use, and the surprising benefits these efforts can have on other industries, much like the impact of the nation's space program on developing technologies.

Let's look at nine projects in three general areas of R&D funded by the SWC over the past several years.

in the reservoir...

In this study group, SWC funding addressed different ways to enhance reservoir recovery and extend and enhance the productive life of marginal wells. The consortium brought existing technology into the field and tested it against the conditions and demands of marginal wells. It also gave a forum for new technology to be tested and refined in the field rather than in the laboratory.

In many instances, the technology in question is complex and expensive. The projects in this category demonstrate how risks associated with costs to expand or enhance reservoir access and well flow can be justified by having greater accuracy and/or control to improve the results. Inevitably, as more producers adopt the technology, costs have been reduced as a result of volume activity. More employment occurs and more production comes on line for the benefit of all.

project recaps

"Hydraulic Fracture Imaging[1]"

Universal Well Services, Inc., (2004-05)

In this project, Universal Well Services, Inc. brought a technology to the Appalachian Basin to create images of hydraulic fractures. Hydraulic fracturing is used to enhance production by connecting larger parts of a reservoir to the well bore. Previously, such technology was used sparingly in this region due to cost. Operators used computer simulated predictive models to design their fracture stimulations. Prior to the technology, there had been no available data to calibrate the models and validate their recommendations, which made use of the process expensive. However, by providing a three-dimensional image, the geometry of a frac is defined as it intersects with natural fracture and stress zones, enabling the operator to better control the frac process and more accurately anticipate results.

1 "Hydraulic Fracture Imaging," Final Report 9/1/04 - 8/31/05; Roger Willis & Jim Fontaine, Award # DE-FC26-04NT42098; SWC Subcontract 2771-UWS-DOE-2098

A better understanding of the geology in the area helps operators answer many fundamental questions affecting costs and profitability. "One of the key outcomes of this project has been to develop and calibrate data not previously available to help identify spacing and location of wells, which maximizes resource recovery," noted principal investigator, Roger Willis. "This way the outlay to treat or re-complete a well is better directed and more economically justified. Our customers are small operators and we wanted to be able to give them better information to make their decisions."

"Control of Water Production Using Disproportionate Permeability Reduction in Gelled Polymer Systems[2]"

University of Kansas Center for Research, (2005-06)

In this project, investigators explored the use of gelled polymer technology to enhance production. Oil was injected into gel formed *in situ* to create flow channels with preferred permeability to oil versus water. The production of water as a by-product of the recovery of oil and gas ultimately interferes with the productivity of a well. Generally wells are treated with a polymer gel that is injected into the well. Oil is flushed through to displace gelant from the wellbore, clean up residual debris and the well is shut in to allow the polymer to set, much like Jello. The gel reduces the permeability to water, allowing the oil to flow. In this project, the innovation was not technology; rather it was the concept of using existing technology in a novel fashion. The concept itself was born out of laboratory research conducted over the past 20 years through Department of Energy funding.

According to Paul Willhite, principal investigator, "Reducing water production to enhance oil recovery has been the holy grail of the industry. In our lab research we had found that if the polymer gel was dehydrated using an oil injection after the well had been shut in and the gel allowed to set, it was possible to further enhance and lengthen the gel's performance in reducing water production." The theory was that such an event would reduce costs in operating (electrical pumping functions) and the oil would flow more productively.

Field tests generally supported this theory, adding the additional benefit of a longer term remediation than conventional treatments yield. However, the current economics of oil prices mandate that incremental improved oil production be substantial to cover the costs of the treatment. Operating savings from reduction of water production are not enough.

Nevertheless, the project significantly underscores the significance of traditional laboratory research to establish the necessary databases that are the underpinnings for creative expansion of current technology. For now, the potential of this treatment concept awaits its turn in the economic life cycle of the industry.

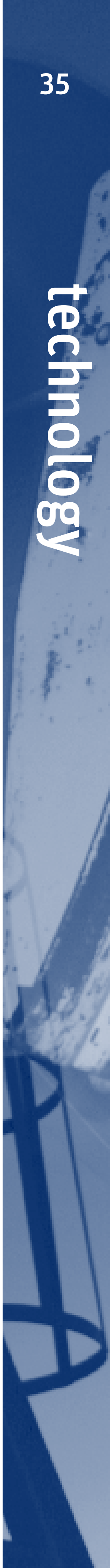
2 "Control of Water Production Using Disproportionate Permeability Reduction in Gelled Polymer Systems," Final Report 7/1/05 - 12/31/06; G. Paul Willhite; Award # DE-FC26-04NT42098; SWC Subcontract 2937-UK-DOE-2098

Hydroslotter Corp: Hydroslotter nozzle for directed slotting-fracturing

"Demonstration of Directed Slotting-Fracturing Technology[3]" Hydroslotter Corporation, (2008-09)

This project investigates a new completion/stimulation technology that increases well productivity by repairing damage in the near wellbore reservoir and by improving collectability. When Hydroslotter joined the SWC in 2000, they were a small, specialty R&D company. Then in 2005-2006 the SWC funded the "Demonstration of Hydroslotter Technology on New York Stripper Wells," project which showed how effective hydroslotting was in making marginal wells economically viable. The SWC was an important factor in Hydroslotter's growth – hydroslotting is now being used all over the country. The goals of the current project are to improve on the previous results by adding a directional component to hydroslotting excavation. This will in turn cause a subsequent hydro-fracture to be more effective than conventional hydrofracturing and softer on the formation. "Bringing a new technology forward in the market is difficult," observed Skip Taylor, the principal investigator. "In the initial stages of research and development, neither a technology nor

3 Demonstration of Hydroslotter Technology on New York Stripper Wells", Final Report 6/1/05 - 12/31/06; Lewis Taylor; Award # DE-FC26-04NT42098, SWC Subcontract 2984-HC-DOE-2098



the company has commercial credibility. The Consortium puts the technology into the public forum where you discuss and demonstrate and prove out the idea in real conditions. This not only reduces the R&D cycle time, but it forces the investigator to distill the R&D and solve real problems in real ways. In addition, the Consortium ensures that each new technology presentation builds on previous projects, which continuously advances technology progress. Whatever is best is what rises to the top, what is at the forefront, and what truly hasn't been done before."

wellbore fluid removal: sub-surface systems...

Studies have shown that 70 percent of all marginal wells face fluid removal problems in their lifetime. As the reservoir pressure decreases, fluids cannot naturally flow to the surface of the well and require assistance. Fluid build-up will eventually kill the well if the fluid is not removed.

The projects in this category all share the experience of expanding technology in response to both field conditions experienced during testing phases and to inquiries made by operators attending presentations hosted by SWC that are geared to disseminate knowledge of funded project results and successes. While project participants acknowledge the significance of the funding, they are even more appreciative of the accountability generated by the process of demonstrating and proving out a concept and the marketing and credibility gained through the various information sharing efforts orchestrated by the SWC. All acknowledge that each of these components are necessary in the life cycle of bringing an idea from concept to market use.

project recaps

"Field Demonstration of a New, Low Cost Hydraulically Operated Insertable Pump for Stripper Wells[4]" Pumping Solutions, (2002-07)

This project is one of a series of projects addressing low cost pumps and separators awarded over a period from 2002 to 2007. In 2000 Pumping Solutions had received a patent for a new type of pump based on a hydraulically driven diaphragm. This novel, low cost production system is used in conjunction with submersible pumps. Very tolerant of debris, it allows the pump inlet to be placed below the perforations in sandy wells. The low placement dramatically increases the production of sand and other debris. Add on technology using small diameter plastic tubing increases pumped fluid velocity to sweep debris to the surface where it can be removed without putting the well

4 "Field Demonstration of a New, Low Cost Hydraulically Operated Insertable Pump for Stripper Wells," Final Report 5/22/02 - 3/12/03; Leland Taylor, SWC Subcontract 2282-PS-DOE-1025

out of service or employing any additional cost. The most recent add-on technology is a low cost gravity separator that uses the volume inside the production tubing as the separator volume.

Principal investigator Leland Traylor commented on the process of developing technology, “One in three products will actually pan out as commercially viable. Our gas separator for example worked perfectly and was capable of separating out pipeline quality gas, so that instead of venting gas as waste and adding to the greenhouse effect, a useful product was created. However, the quantities are modest and many wells lack sufficient access to a pipeline. Although it works, it is not an economic solution at this time.”

Nevertheless, what started as a creative idea blossomed into several important applications that were developed and tested in the field and made ready to use within a very short time cycle. And, while the idea began as a solution for marginal wells, industry experts have estimated that water interferes with the production of natural gas in nearly 70 percent of wells drilled. The simple resilience of this pump makes it readily applicable to other well types.

“Real Time Remote Field Monitoring of Plunger Lift Wells to Reduce Production Down Time and Increase Natural Gas Production[5]”

Tubel Technologies, Inc. (2003-07)

This project is also one of a series of related projects. The first project funded by the SWC related to a wireless gauge for use in downhole applications to increase the amount of natural gas that is produced from wellbores. The ability to remove water or to increase the reliability of the pumps used to lift water from downhole are significant requirements to producing natural gas at reasonable cost and optimizing the production process. In this project, the goal was to eliminate the cable that is normally deployed in wellbores for gauge power and communications in order to decrease the cost of the system and the operational cost to install a gauge in a well. The investigators also sought to develop a small diameter tool that could be deployed in 4½ inch casing.

In addition to reducing costs, the elimination of the downhole cable also decreases the danger of losing communications from downhole to the surface or the risk of the production string becoming stuck in the well due to a cut in the cable. The deployment of a gauge improves the production of gas and decreases the failure rates associated with rod pumps.

The new wireless gauge was completed successfully within 12 months and the system was deployed in frac work with coil tubing to optimize the frac process and to increase natural gas production. The system is also used in real time pressure build up tests providing the users real time information related to the downhole pressure thereby decreasing the

5 “Real Time Remote Field Monitoring of Plunger Lift Wells to Reduce Production Down Time and Increase natural Gas Production,” Final Report 6/1/05 - 5/31/06; Paul Tubel, Award # DE-FC26-04NT 42098, SWC Subcontract 2935-IT-DOE-2098

amount of time the well stays shut in for testing. The second project related to the development of a system to optimize the plunger lift process. The purpose was to develop a surface system capable of listening for noise generated by the plunger disk as it traveled in and out of a wellbore. The noise was to be processed to provide information to the operator related to the location of the plunger disk in the wellbore, including when the disk reached the bottom of the well. The goal was to have a better understanding of the plunger location to optimize the lifting of water from the wellbore to the surface, which would allow gas to flow freely to the surface. A surface panel was developed that processed data received from a microphone installed at the wellhead that picked up the noise generated by the movement of the plunger. The system was able to process the data to determine when the plunger passed a tubing collar, which provided the location and travel time of the plunger. Also the noise was processed to determine when the disk reached the springs located at the bottom of the well.

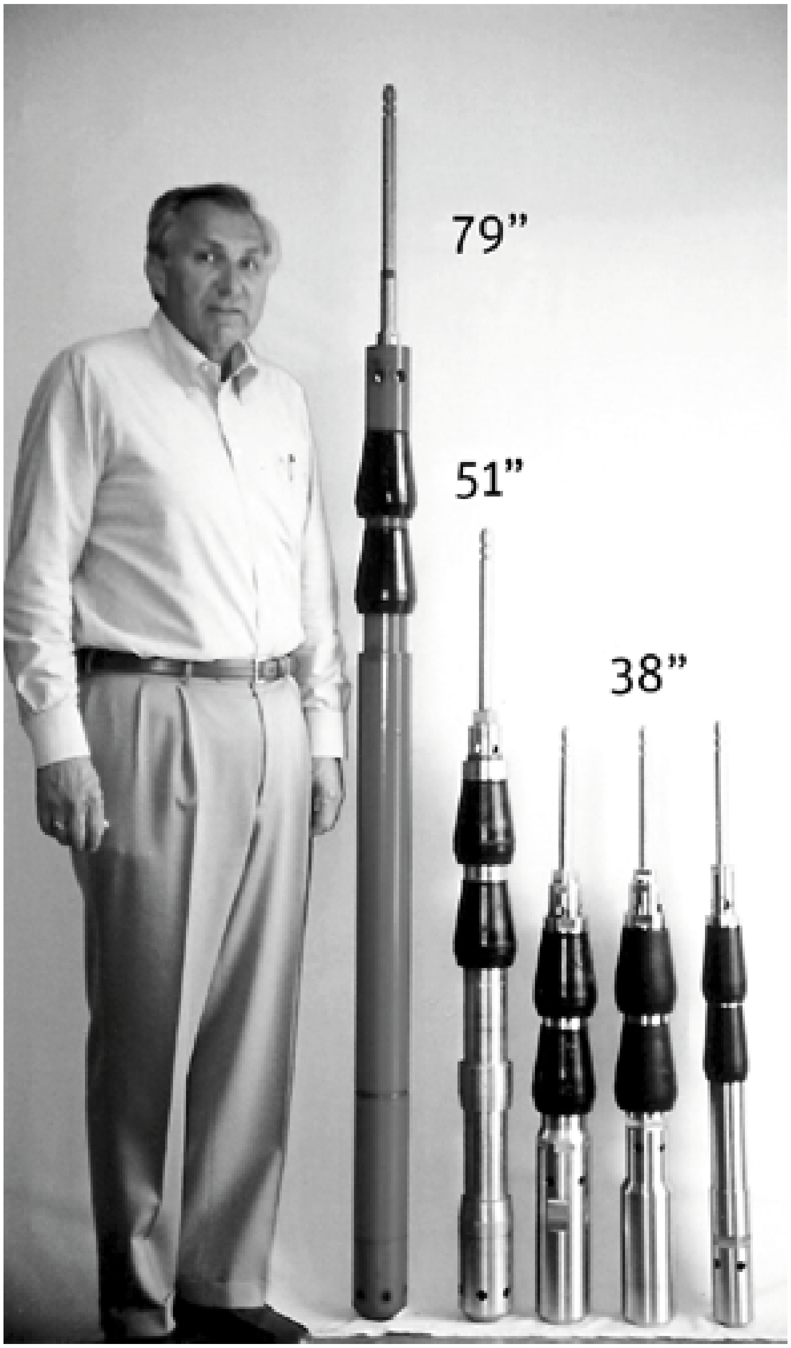
The third project was a new version of the plunger lift optimization system where the noise captured at the wellhead as the plunger disk traveled in and out of the wellbore was transmitted wirelessly to a control room at a remote location. The digitized noise could be heard in real time by the operator to evaluate the performance of the well. The operator could monitor hundreds of wells from a single location and could identify potential well and plunger lift problems fairly quickly to correct problems with minimum production losses. The operator could also decrease the manpower costs related to having people travel from well to well to verify if the plunger system was working properly. The system was also able to remotely process the data received from the wells.

Paul Tubel, principal investigator, describes the process of technology development and refinement in this way, "We were a small company. There was no money from the industry invested in this kind of research and development. With SWC, the process was simple and straightforward. The proposal was easy to lay out, the decision process took six weeks and we had two weeks to get up and running. From there, testing in the field and getting feedback immediately from customers made things go more quickly and more smoothly. Then as we presented what we had accomplished, interest from members of the audience prompted further refinements and expansion of the concept and applications."

"Re-fit Two Stripper Wells of Existing Large Diameter or Open Hole Completion[6]" Brandywine Energy and Development Co. (BEDCO) (2005-08)

This project involved the development, construction and deployment of a prototype pump, a Gas Operated Automatic Lift PetroPump. The GOAL PetroPump is configured with a tool/valve assembly utilizing natural downhole geologic pressure to automatically

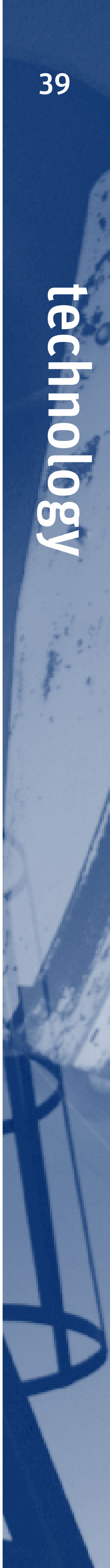
6 "Re-fit Two Stripper Wells of Existing Large Diameter or Open Hole Completion," Final Report 2/1/08 - 4/30/08; C. Hunt, G. Swoyer, P.M. Yaniga, Award # DE-FC26-04NT 42098, SWC Subcontract 3541-BE-DOE-2098



BEDCO GOAL PetroPump - Gerald Swoyer and the GOAL PetroPump tools with the original design on left and smaller tools at right are the current design

lift fluids to the surface. The tool descends downhole into a preset depth/volume of fluid above the tool, stopping at that point while letting pressure build under the tool until there is sufficient pressure differential to lift the tool and fluid load to the surface. At the surface it automatically opens after delivering fluid and achieving neutral pressure differential below and above the tool allowing the actuator to open and enabling subsequent tool descent. The introduction of spool-able nonmetallic tubing in the well reduces friction loss differential by five to seven pounds per square inch of pressure (psi), greatly improving the quantity of fluids to be lifted and hydrocarbons that could be recovered from the reservoir.

With only two moving parts and no requirements for electrical power to operate the pump, the cost to run the GOAL PetroPump proved much less than conventional pump jacks, with greater reliability and production. Principal investigators Paul Yaniga and



Gerald Swoyer are emphatic about the benefits of industry networking and applied research to bringing new technology online. "You get tool designers working directly with operators and manufacturers and prove the concept more quickly because you design for actual field conditions, not theory. Real conditions mean real improvements because you gather first hand working knowledge building for field hands. If it isn't easy to install and operate, they won't use it."

on the surface...

The projects in this category address fairly revolutionary technology aimed at improving the flow and the quality of the natural gas and oil produced. The new technology not only achieves its intended purpose, but also converts waste into useful by-products.

Because of their low yield, marginal wells are very sensitive to price increases for oil or gas, operating costs or methods to increase flow. In today's environment, prices for oil and gas are generating more interest and support for domestic exploration and production. While the current price environment is attractive, the other challenges impacting marginal well production, reducing operating costs and enhancing well production, remain. Where technological enhancements can address operating costs and improve flow, the impact is tremendous.

project recaps

"Desalination of Brackish Water & Disposal into Waterflood Injection Wells[7]" Texas A&M University (2003-07)

This project addresses the challenge of managing and disposing of produced water or brine, which are by-products of the production of oil and natural gas. Current methods that include re-injection are costly to the industry and to the environment.

In recent years, population growth, drought conditions and the significant development of unconventional oil and natural gas resources have seen water become as scarce and valuable a resource as hydrocarbons, causing a few media pundits to label water "the new oil." A multi-stage fracturing process for a single well in a gas shale formation can consume six to seven million gallons of water. And since this water cannot be reinjected into the gas shale formation, its disposal can be extraordinarily expensive.

Knowing that desalination of ocean water through reverse osmosis technology has been an accepted technology for several years, this project's members evaluated the technology for oil field operations. Dave Burnett, principal investigator, comments, "Around 2000, I was working with a friend of mine in the food processing business. They use membranes to separate various elements. At the same time, in Texas, water was becoming so expen-

7 "Desalination of Brackish Water & Disposal into Waterflood Injection Wells," Final Report 6/1/05 - 12/31/06; David B. Burnett & Harold Vance, Award # DE-FC26-04NT 42098

sive and hard to come by that it occurred to me that it might be easier to make water pure than it would be to reinject it for disposal."

Collaborating with oil and gas operators, and with the financial assistance of the Department of Energy, the project developed a mobile desalination unit capable of processing and purifying produced water suitable for irrigation, livestock and other uses. The project combined the expertise of the university in research and the legal challenges of licensing; governmental units in the certification and acceptance of the resulting product; and the private industry in the commercialization process.

In 2007, GeoPure Water Technologies, LLC licensed GPRI Designs™ Desalination technology to commercialize the process developed at the university. As a result, this project now reports a number of oil field projects in the works.

"Very Low Cost Stripper Well Booster Compressor[8]"

Combined Heat & Power, Inc. (2007-08)

This project involves the design and manufacture of a specialized compressor, known as the Polyvane Compressor. The device is a low cost, dynamic compressor using an innovative internal flow-path that allows exceptionally simple machining and construction, fabricated largely out of non-metallic materials.

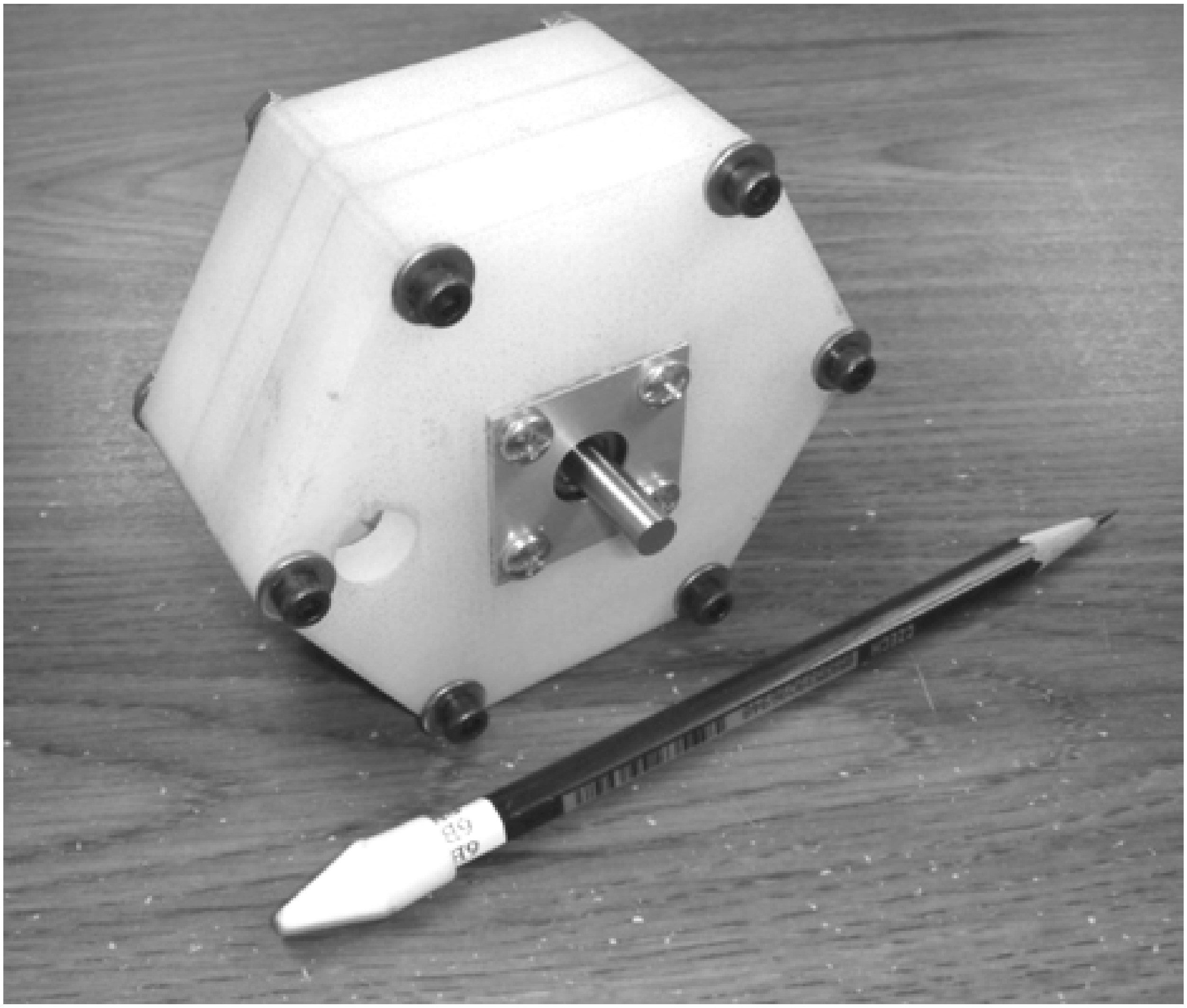
According to the principal investigator, Ewan Choroszylow, the technology was patented four or five years ago, but the concept was set aside as the company pursued sales of it's Guided Rotor Compressor, a larger high pressure device. It was suggested by the New York State Energy Research and Development Authority that the Polyvane concept might be used to reach the marginal well market.

"We first developed the prototype in aluminum to prove out the concept. Using plastics would make it inexpensive, but the device had to be capable of functioning with natural gas in direct sunlight. Tests were carried out by GE Plastics to identify suitable plastics. We've resolved the technical issues related to that and are now approaching field testing after fabrication in plastic. Combined Heat and Power, Inc. designs, tests and assembles the device, but outsources the machining."

Combined Heat & Power, Inc. is a privately held company and not a source of venture capital. New technologies are generally funded through cash flow with some bank assistance. Access to SWC funding enabled the company to take a patented concept off the shelf, develop a prototype to prove out the concept, and construct the first working product. More importantly, it brought the company into direct contact with marginal well operators who could provide direct input to the development of the device, as well as speak to the need for it.

"Without this seed funding, this idea might never

8 "Very Low Cost Stripper Well Booster Compressor," Quarterly Report 11/5/07 - 1/31/08; Ewan Choroszyow, Award # DE-FC26-04NT 42098, SWC Subcontract 3462-CHP-DOE-2098



Combined Heat and Power subscale plastic prototype of a Complete Booster Assembly made from Duroform, a nylon based material

have come forward from the concept stage. We have limited visibility where the wells are, using a non-exclusive distributor network," Choroszylow concluded.

"A Low-Cost Micro-Scale N_2 Rejection Plant to Upgrade Low BTU Gas from Marginal Fields[9]"
Kansas Geological Survey (KGS), University of Kansas Research Center and American Energies Corporation, (2007-08)

About 17 percent of known natural gas reserves in the United States are categorized as sub-quality or low-BTU due to the significant presence of carbon dioxide and/or nitrogen. Much of this gas is located in marginal fields and remains shut in behind pipe and thus unproduced.

Project investigators developed a 2-Tower Micro-Scale Nitrogen Rejection plant designed to be

9 "A Low-Cost Micro-Scale N_2 Rejection Plant to Upgrade Low BTU Gas from Marginal Fields," Quarterly Report 11/1/07 - 1/31/08; Saibal Bhattacharya, Dr. Lynn Watney, Dr. Dave Newell, Rudy Ghijsen, Mike Magnusen; Award DE-FC26-04NT 42098, SWC Subcontract 3447-UK-DOE-2098

Plant towers, surge tank and the compressor at the 2-Tower Micro-Scale Nitrogen Rejection Plant, Elmdale field, Chase County, KS

economic at low feed volumes (less than 250 Mcf per day). The remarkable aspect of the plant that contributes to its low-cost is that it is assembled completely from off-the-shelf components. Upon completion of the project, the blueprints of the plant will be made freely available to the public at the project Web site: *http://www.kgs.ku.edu/PRS/Microscale/index.html*.

Given its simple layout, the plant can be disassembled and re-established at another location as needed in three days, a completely do-it-yourself marvel of technology especially suitable to marginal operators with limited resources.

Principal investigator Saibal Bhattacharya explained that the development of this concept was inspired by the challenge Kansas pipeline operators faced as gas fields aged and production of high BTU gas declined.

"We developed the first version of the plant and modified it after learning from the results of our field tests. At present we are optimizing the plant settings to improve the nitrogen efficiency."

Currently the plant upgrades 700-750 BTU per cubic foot feed to 940-990 BTU per cubic foot with a 70 percent hydrocarbon recovery efficiency. Less than 10 moving parts and skid-mounted units handle fluctuating fee volumes, and the unit is easy to build, operate and maintain. The plant is also energy efficient, with the compressor running on feed gas rather than electricity, and batteries are charged by the compressor engine making it ideal for operation at remote locations outside the electric grid.

conclusion

The potential impact of technology on marginal well production can clearly be of strategic significance. However, as Dave Burnett, an innovator with Texas A&M University put it, "Funding is the engine that drives research. Without funding and the opportunity to test the idea in the field, a screwy idea just stays a screwy idea."

In addition, technology innovators point out that the benefits of collaborative development extend to the commercializing process.

The gilt thread weaving throughout these projects is not just about the timely funding provided by the SWC, but also about the strength of the relationships formed among its members. The application of working capital, expertise, and access to operators in the field has created a prolific environment for technology expansion in broad and practical ways. In many instances, the projects have significant merit not only for their economic contributions, but also for their environmental and conservation contributions. This is the face of those dedicated to producing and conserving America's oil and natural gas – resilient, innovative, entrepreneurial, stewards of the environment and its resources.

For more information about marginal wells contact the Stripper Well Consortium for a copy of the video :

"Independent Oil: Rediscovering America's Forgotten Wells."

SWC@ems.psu.edu
or
www.energy.psu.edu/swc

appendices

appendix – economic impact studies

Economic impact studies have been typically used by economists and planners to examine the effects that a new industry or event may have on local or regional economies. In this context, suppose a new factory or other manufacturing facility is contemplating moving into a region. In order to help determine the tax subsidies or other inducements which governmental authorities may be willing to offer the new business to locate in their area, economic analysis is used to predict the possible positive effects of job creation, enhanced future tax base, and other improved economic results of the arriving industry. With the anticipated rise in employment comes an increase in spending generally in the local area as workers in the imported facility purchase goods and services with their wages. But this new spending has an ultimate effect in the economy larger than its initial impact. As incumbent merchants sell their products to the recently arrived workers, they have additional income to spend with other local sellers, who then have additional disposable funds, and so on. As each round of spending works its way through the economy, some leakages occur when individuals do not consume all of the new earnings, but ultimately the impact of the new industry will be greater than the initial infusion of spending. This phenomenon is known as the multiplier effect. One of the difficulties in this type of economic analysis is determining the appropriate multiplier.

Multiplier estimations for local economies have generally been based on three types of models: input-output, economic base, and regional income. Each of these approaches has distinct advantages and disadvantages. Depending on the situation being evaluated, either of these methods, or a combination of them may be appropriate.

Input-Output models (I-O) appear to be the most reliable, and the most comprehensive, tool for local and regional economic analysis. In this model, an accounting framework called an I-O table is constructed for many industries showing the distribution of inputs purchased and the output sold. Multipliers are then developed for each industry and their interrelations are shown. The most accurate of these models is constructed using survey techniques and is costly and time consuming. Some efforts have been made to create short-cut methods (Drake 1976; Kuehn et al. 1985), but the reliability of non-survey I-O models has been questioned (Stevens and Trainer, 1976; Park et al., 1981; Kuehn et al., 1985).

In the economic base technique, multipliers are developed as ratios of total regional income or employment to income or employment in basic (or export) sectors (Olfert and Stabler, 1994). This approach is less costly than other methods, but also has been shown to be less accurate in estimating local or regional multipliers than other procedures. Other criticisms of this approach include questions about its theoretical underpinnings and doubts related to its application (Vias and Mulligan, 1997).

Regional income models can be constructed using published information or from a combination of survey data and published (Archer, 1976; Thompson, 1983; Glasson et al., 1988; Rioux and Schofield, 1990). Researchers using this method estimate some general relationships from published data and then use survey data to focus on specific relationships. While this method keeps costs low, it still allows for some first-hand information to help estimate critical relationships used to calculate appropriate multipliers.

Almost all of these methods for calculating the multiple impact of a monetary infusion into an economy assume that an industry or event is not a part of the local or regional economy initially or that exports from a region create a flow of income into the region. Whether by the construction of a new power plant, an autonomous increase in government spending, or the importation of a rock concert (Gazel and Schwer, 1997), it is the specific relationships between the new income and the incumbent economic actors which determine the specific multiplier effect. Because of the difficulty in determining an associative relationship, much less a causal one, between the spending patterns of various economic sectors, the validity of specific multipliers is highly speculative under any method. However, a common source for economic multipliers is the Department of Commerce's Bureau of Economic Analysis. As mentioned above, we use their RIMS II (Regional Industrial Multiplier System) multiplier here for Industry 211000, Oil and Gas Extraction.

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about the marginal well commission

The Oklahoma Commission on Marginally Producing Oil and Gas Wells is an Oklahoma state agency, funded by the oil and natural gas industry, with a purpose of protecting and promoting Oklahoma production of crude oil and natural gas. Th e organization's purpose is to serve the operator with its technology transfer programs; to serve the state by making sure that its most vital resource is continuously produced and not prematurely abandoned; and to serve the public as an information source regarding the importance of the industry in their lives and the state in which they live. For more information, visit www.marginalwells.com.

about the stripper well consortium

The SWC is an industry-driven consortium that is focused on the development, demonstration, and deployment of new technologies needed to improve the production performance of natural gas and petroleum marginal wells. SWC is comprised of natural gas and petroleum producers, service companies, industry consultants, universities, and industrial trade organizations. The Strategic Center for Natural Gas, the National Petroleum Technology Office, and the New York State Energy Research and Development Authority provide base funding and guidance to the consortium. By pooling financial and human resources, the SWC membership can economically develop technologies that will extend the life and production of the nation's marginal wells. For more information, visit www.energy.psu.edu/swc.

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. Th e Illustrated Petroleum Reference Dictionary. 4th ed. PennWell Books: Tulsa, 1994.

INTERSTATE
Oil & Gas
COMPACT COMMISSION

P.O. Box 53127, Oklahoma City, OK 73152
Phone: 405.525.3556 • Fax: 405.525.3592
www.iogcc.state.ok.us